

Treatment for Lymphedema of the Arm—The Casley-Smith Method

A Noninvasive Method Produces Continued Reduction

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Presented at the American Cancer Society Lymphedema Workshop, New York, New York, February 20–22, 1998.

The author thanks the many therapists who provided patient research data, too numerous to name individually, but, in particular, the University of Adelaide; the Lymphoedema Association of Australia; the Adelaide Lymphoedema Clinic; Hamilton Laboratories, Adelaide (for supplying benzopyrones); and GEMINI, France (for the Palmmr 900 mercury device).

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Received July 2, 1998; accepted August 20, 1998.

BACKGROUND. This paper gives an outline of the Casley-Smith method for the treatment of lymphedema of the arm. It includes a brief summary of the development of manual techniques and the terminology applied to them.

METHODS. The four principles of this method are skin care, manual lymphatic drainage, compression in the form of bandaging and/or garments, and exercise. The massage techniques, especially where they differ from other schools, are described in some detail, as are the principles that apply in compression and maintenance of reduction in lymphedema.

RESULTS. The results of this method have been analyzed both in Australia and in the United States and are discussed briefly. Mention is made of the benefits of the benzopyrones, which have been used for many years, when added to the above treatment. Both benzopyrones and exercise will produce a continued reduction after the treatment course. They are particularly useful in a less compliant patient. It is stressed that the effect of patient compliance, particularly after treatment, makes a great difference to the ongoing success of the regime.

CONCLUSIONS. A comparison is drawn between the efficacy of various current treatments and their cost. This shows that this combined and conservative method of treatment should be considered before recourse to pumps or surgery. The latter seldom achieve the results of decongestive lymphatic drainage, and, in the long term, they are more expensive. Certain preventive measures may be indicated following, e.g., mastectomies. Prevention of the onset of lymphedema is of extreme importance. However, a return to as normal a lifestyle as possible by the patient is also essential. The earlier treatment begins after the onset of lymphedema, the better the prognosis for the patient. Lymphedema can and should be treated.

Cancer 1998;83:2843–60. © 1998 American Cancer Society.

KEYWORDS: lymphedema, compression, exercises, benzopyrones, massage, lymphatics, postmastectomy.

The Nature of Complex Physical Therapy—History and Nomenclature

Winiwater was the first to introduce physical therapy for lymphedema.¹ It then fell out of use, why is uncertain, especially because techniques of *lymphatic massage (drainage)* were improved in the 1930s by Vodder.² These were modified and extended in practice by Asdonk and Leduc, and later by Földi.

Perhaps the neglect was because Vodder's techniques were directed toward making essentially normal lymphatics work better (e.g., to reduce the edemas of trauma, etc.). They were not designed originally to reduce lymphedema caused by damaged or nonexistent

lymphatics—i.e., they did not transfer the lymph to other, still normally drained regions (see below) to the extent that we do now.

Good compression garments were unavailable at that time, and, without these, the reductions produced could not be maintained. Therefore, repeated treatments were necessary. This may have made surgery seem a better option. However, the promises of surgery (reduction operations, lymphovenous or lympholymphatic, anastomoses, and, more recently, liposuction) except in a few special cases, have proved mostly to be disappointing.

By contrast, the recent, very considerable improvements in our knowledge of the detailed anatomy of the lymphatic system by Kubik³ have allowed many important improvements to be made to the physical therapy of lymphedema, including understanding what is happening and applying this in practice. These improvements have now been refined, improved, and collected into a regimen called *Komplexe physikalische Entstauungstherapie*,⁴ literally translated, *complex decongestive physical therapy*.

The work done by the Földis in their clinic and the fact that they published their results finally gave credence to conservative treatment, proving that it was extremely successful in reducing lymphedema and that results could be maintained given patient compliance.⁵⁻⁷ It was this and the work on the physiology and pathophysiology of the microcirculation and the benzopyrone group of drugs that was done by John Casley-Smith in Oxford and by him, his coworkers in Australia,^{8,9} and Földi, as well as that of Kubik³ on the anatomy of the lymphatic system, that were the most instrumental factors in determining the techniques I have developed for the treatment of lymphedema.

“Decongestive” (“undamming” is the more meaningful, but nonmedical translation) does not have the same connotation in medical English that “Entstauungs” has in German (it makes one think of congestive cardiac failure or some lung diseases). We omit it and use simply “complex physical therapy” (or CPT) to designate this method. We use “physical therapy” rather than “physiotherapy,” because this has wider implications internationally and therapeutically. The Földis now often use “*combined physiotherapy*.” In a few parts of Australia and the United States, the word “physical” is restricted by law to physical therapists. In such cases, the alternative “complex lymphatic (or lymphedema) therapy” (CLT) is used. It is identical to CPT.

Again, the term “manual lymphatic drainage” (MLD) is copyrighted in the United States and refers to the original Vodder method.² Therefore, we refer to “special massage” for the treatment of lymphedema.

Földi has introduced the term manual lymphatic therapy (MLT) for this part of CPT. We (and others) greatly regret this alphabetical confusion, but there is no alternative.

A consensus was agreed upon in New York in February, 1998, in which the Földis, Leduc, the Vodder School (Kasseroller), and Casley-Smith agreed to the term decongestive lymphatic therapy (DLT) as a suitable name for this treatment. We were in total agreement with the four principles involved (see below); however, with the lymphatic massage part of the treatment, there was disagreement on the name. Földis and Casley-Smith opted for MLT. Leduc and the Vodder School opted for MLD. It must be stressed that, although the principles followed are the same for each school of therapy, the massage techniques vary between schools (although parts are very similar). The only way to choose between one another is to evaluate the results of treatment that have been analyzed statistically and published.

CPT for Lymphedema of the Arm

CPT involves four aspects: 1) skin care and the treatment of any infection; 2) a special form of massage; 3) compression bandaging (a garment is prescribed at the end of the course); and 4) special exercises that complement the massage. It has two phases: 1) a treatment course of up to 4 weeks or more gaining the reduction and 2) maintaining and continuing the reduction by continuing with compression, exercises, and skin care.

The massage is based on the concept of emptying the truncal regions first to give the lymph from the periphery somewhere to go; i.e., an empty reservoir is created. Only then is the limb massaged.³ The proximal region of the limb is always cleared first, then the massage is extended distally. Starting at the distal end and attempting to push the lymph into the unemptied, proximal regions is contraindicated. Other deeper abdominal work may be performed by a well trained therapist that will aid in the clearance of this region and create a larger reservoir for drainage from the thoracic quadrant.

Once a plateau in the reduction is reached, the later massage concentrates on enlarging collateral lymphatics linking obstructed lymphotomes to normal ones. For a single lymphedematous limb, massage and bandaging takes at least 1 hour, but a better result is obtained if a longer time is spent.

A course is repeated after the body's connective tissue has been given time to remodel into its new, less edematous shape. Even the loose skin remodels. This happens fairly slowly, taking 6–9 months. For this reason, courses usually are spaced 1 year apart. They

are repeated as often as necessary. Each repetition usually results in the removal of about 50% or more of the edema remaining after the previous course.

Repetition courses will not be necessary if the arm has been reduced to the normal size by the first course of treatment and if the patient is compliant, wears their garment, and continues with some self-massage and exercises. When necessary, the length of the course may be reduced to a few days. Of course, this saves both the expense and the patient's and therapist's time. If the therapist is expert enough in the first place, and if patient compliance is good, then a second course should not be necessary with lymphedema of the arm.

There are certain diseases that potentially may cause considerable problems when combined with lymphedema and CPT treatment. It is important to be sure that these are not present before starting physical therapy, because this can move a lot of fluid into the blood quite rapidly. Hence, congestive cardiac failure and renal disease must be diagnosed. It is still possible to treat such people, but care is needed that the venous pressure is not raised too much. This is quite possible with pumps,¹⁰ and CPT is likely to do the same. If CPT is to be performed, then, in the first few days (which is when most of the fluid is moved), it is necessary to watch the jugular venous pressure to make sure that it is not increased by more than 1–2 cm of water.

Similarly, diabetes must be well controlled, and too much pressure must not be used in compression bandages and garments. Of course, this also applies if severe arterial disease is present in the limbs, and if there are lymphovenous shunts or Raynaud's disease. Apart from severe arterial disease, CPT is contraindicated over radiation injuries, angiodysplasia syndrome, occult infection, and venous thrombosis. However, if the areas involved by these can be located specifically, CPT can be used elsewhere, especially on the trunk and alternative limb drainage areas.

Other conditions can worsen lymphedema and should be treated. Obviously, skin conditions of the lymphedematous limb are important, especially infections and other inflammation.

Combined Methods of Treatment

Skin care

Much can be done in the early stages of lymphedema and to a "limb at risk" to prevent skin problems. The skin must be kept supple, moist, and in good general condition. Skin problems can cause a local high-protein edema that adds to the load of an already inadequate or over-burdened lymphatic system.¹¹ Obviously, trauma to the limb (e.g., knocks; abrasions or

cuts; burns, including sunburn; and insect bites) must be avoided carefully and, if they occur, treated.¹² The limb also must be kept spotlessly clean and dried gently and very carefully. A mineral-oil cleanser is less drying and better for the skin than normal toilet soap.

The raised temperature and raised interstitial proteins that are present in lymphedema provide the perfect medium for both bacterial and fungal growth.^{13–17} It is of particular importance to check for any fungal infection and treat accordingly. Although this type of infection is found most frequently between toes, it can be spread quite easily, and it is not uncommon for it to develop under the fold of a breast and, thus, to worsen the problem.

Problems of bacterial infection, again, should be dealt with immediately when they occur. They will worsen the condition and can be life threatening. They are treated normally with antibiotics. Most respond to penicillin as long as the patient is not allergic to this drug.

Massage techniques for lymphedema

The length of a treatment course and that of each separate treatment session *should* depend on the needs of the individual patient. However, this may not be possible. It may be dictated by a number of factors, e.g., hospital constraints and the availability of therapists. Various constraints of the patient will also affect it, such as money, time available, and travelling distances from the clinic, etc.

The time spent on massage on a consecutive daily basis can range from 40 minutes to 90 minutes or longer per limb involved. If only 40 minutes are available, then at least 30 of these minutes should be spent clearing the trunk and the lymphotomes adjacent to the affected limb in the initial stages. This will produce a much better result than spending more time on the limb itself. If a longer treatment time is possible, then up to 1 hour may be spent clearing the trunk, and, of course, the results will be much quicker and better than in the former situation.

After massage, the patient is bandaged with a gauze sleeve, padding, and bandages of low elasticity ("short stretch") commencing at the distal end of the limb. Time must be allowed for bandaging the limb or limbs after treatment (20 minutes are probably minimal for an experienced therapist).

Massage is done on consecutive days over the necessary period rather than two or three times a week over a longer time. The limb needs to be cleaned, and the bandages must be changed and adjusted daily.

The actual length of the treatment period will vary with the severity of the lymphedema, its cause, and the number of limbs and areas of the trunk affected.

Maximum reduction for a single limb should be obtained in 7–10 days if other complications are absent (e.g., a fibrotic cuff caused by previous pressotherapy). The extension of therapy (e.g., 4 weeks) should further promote the enhancement of collateral drainage and the further breakdown of fibrotic tissues.

Good results are much easier to achieve if treatment is commenced as soon as the limb shows signs of swelling. At this stage the tissues are soft, the skin and fascia have not been stretched greatly, excess fibrotic tissue has not formed, and the elastic tissue is still functional. Obviously, the longer the edema or the lymphedema has been present, the more difficult and longer the treatment becomes, and the more often it will need to be repeated. In the early stages of lymphedema, it is really only the excess fluid and protein that need to be removed; the collecting lymphatics need to be assisted and some new collateral drainage needs to be opened. When much fibrosis is present, many new tissue channels must be made through this before any real drainage is possible. The tissue channels will be increased as the fibrotic tissue softens, and more fluid can be moved.

The second course of treatment may or may not be much shorter than the first course. This depends on the condition of the limb and the patient's socioeconomic and even geographic circumstances. If the limb is continuing to reduce on a steady basis, then a second course is not necessary.

It should be pointed out that, as the edema is removed, oxygenation of the tissues is improved greatly. Hence, the skin changes regress: hair follicles and sebaceous glands function once more, hair regrows, and the skin becomes thinner and more supple. If there is skin discoloration, then this should return to normal. Other symptoms of lymphedema, such as pain, immobility, stiffness of the joints, paresthesia ("pins and needles"), etc., should also disappear.

This method is particularly good for the treatment of lymphedema. However, the same principles of drainage are of great help in the treatment of any high-protein edema: acute injury, chronic venous insufficiency, and ulcers.

The body has a number of drainage areas ("lymphotomes") with "lymphatic watersheds," i.e., divisions between different lymphatic drainage areas, between them.³ If the normal drainage of one lymphotome is blocked, then the lymph can drain only into the adjacent lymphotomes. Correct massage causes the collateral lymphatics (in the superficial and deep lymphatic networks) that cross these watersheds to become larger and to carry more lymph to the

normally draining lymphotome. It may also cause proliferation of these vessels.

This applies particularly to the trunk, but also to the limbs. A lymphotome of the trunk drains to axillary or inguinal (groin) nodes. If one of these is blocked, then collateral pathways must be established to take the lymph from this lymphotome to the adjacent lymphotomes and, thence, to the intact axillae/groins.

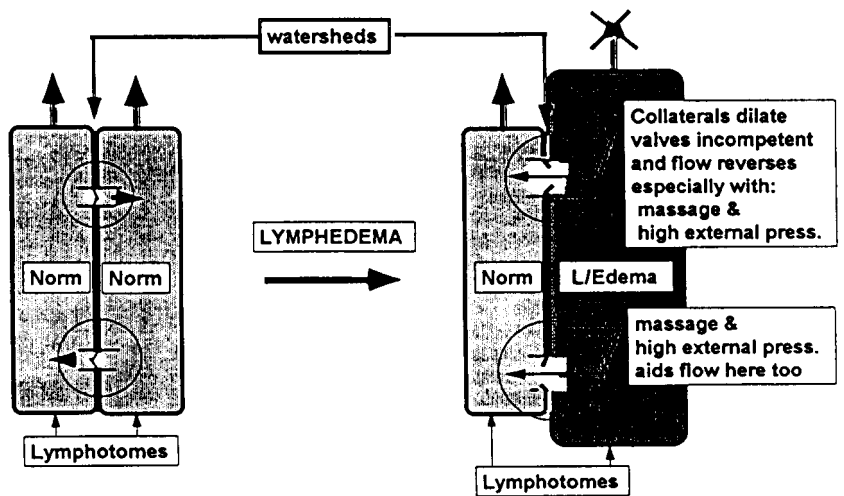
A major part of the rationale of the massage is to force lymph *gently and slowly* across the lymphatic watersheds, dilating the collateral vessels, thus allowing alternative drainage into the collectors of a normal region. Half of the valves of these collectors face in the correct direction; the rest are incompetent because of the lymphedema (see Fig. 1). Hence, this passage across the watershed is relatively easy.

The other function of the massage is to move tissue fluid into the lymphatics^{18–20} (the massage makes the initial lymphatics pump)²¹ and then along these through their usual collecting lymphatics (with the massage enhancing their pumping),^{22,23} through the lymph nodes that are repeatedly emptied. Thus, it removes excess protein from the tissues and the stimulus for formation of fibrotic tissue.^{24,25}

In some cases (e.g., when deep lymphatics are blocked), we rely on the very superficial lymphatics to remove the fluid.^{26,27} This network has no valves. There is a considerable dermal backflow from deeper, overloaded lymphatics that can be cleared easily to a different and functioning set of nodes through this network. This can be damaged by reduction operations, including liposuction, in which it is excised and removed. It also can be damaged by too much pressure during massage^{28–30} or by pumps if they are used with too much pressure, which is often the case. A fibrous cuff often is built up at the proximal end of the limb, thereby constraining any superficial drainage that was available previously from the limb, where the deeper and collecting lymphatics were unavailable for drainage due to surgery and/or radiotherapy. In some cases, this is the only pathway for drainage from the limb. Careful preservation of the network, therefore, is of paramount importance. Massage techniques to increase pumping of deep vessels, therefore, are not indicated when relying on these vessels.

The nodal areas and trunk need to be cleared briefly again and again as the massage proceeds more distally down the limb. When clearing an arm, the therapist needs to return to the proximal areas that have been cleared previously, and these areas must be then cleared through the particular truncal pathways being used for further drainage. To prevent overloading of vessels that are blocked at a more proximal point, drainage to them may be blocked temporarily

FIGURE 1. A diagram of the collateral lymphatics crossing the watershed. In the normal situation (left), some lymphatics have valves pointing one way, and some have valves pointing in the opposite direction. In lymphedema (right), the lymphatics that direct flow out of the lymphedematous lymphotome simply carry more lymph; those that formerly directed flow into it have their flow reversed. Such reversed flow is possible because the deeper collaterals are dilated, and their valves are rendered incompetent. High external pressure (from compressive bandaging) and massage assist in these increased lymph flows. Norm, normal; L/Edema, lymphedema.



by external pressure with the hand. Then, lymph from the more distal parts is forced gently through the chosen alternative route.

Finally, there may be very hard, fibrotic regions—sometimes forming bands. It is necessary to use a stronger massage pressure to “break” new paths (tissue channels) through these regions. Of course, these channels do not have valves and cannot pump lymph as the lymphatics do. On the other hand, they do allow tissue fluid to pass to regions where true lymphatics exist. (These regions *must* be maintained by graduated compression, because one is usually trying to make the fluid flow upward against gravity.)

The early part of the massage technique concentrates on clearing the adjacent normal regions, increasing pumping by and enlarging the existing collaterals, and softening fibrous tissue, thus reducing the limb. The latter part concentrates on increasing collateral drainage and a greater time is spent on the limb, yielding further reductions. Thus, it is vital to know where blockages have occurred and which are the adjacent, normally draining lymphotomes. Daily circumference measurements help in determining whether one’s judgment has been correct.

Massage pressure. This particular type of massage should not cause redness or pain; it is quite gentle. It is stronger when trying to force fluid through sclerotic tissue. The use of excessive pressure can damage the initial lymphatics.^{26,30} Learning to use the correct pressures for the lymphatic system is an important part of the training for such a massage.

The initial lymphatics in particular are very fragile. The superficial network lies just below the skin surface. Therefore, a very light pressure will move lymph through these vessels.

Heavier pressure. Heavier but very slowly moving pressure is used when forcing the lymph across a watershed, dilating the collateral lymphatics. A heavier fingertip pressure is also used over the lymph nodes, again with the pressure moving only in the direction of lymph flow.

When deeper pressure is used on fibrotic areas of a lymphedematous limb, this must be counteracted afterward by bandaging firmly. This is to prevent further leakage from the superficial lymphatics whose endothelial junctions may have been opened inadvertently or their endothelium torn during this massage. If, for some reason, bandaging is not being used, then this type of work must be omitted. If it is not, then one will have created leakage of vessels, raised the protein content of the tissues, and probably increased local skin temperatures. These all lead to the possibility of infection and more edema, which will also tend to cause further general swelling. However, such massage cannot be neglected but must be performed with the knowledge of the potential for damage, and care must be taken to counteract it.

These techniques rely entirely on being able to move the hands and fingers over the skin very slowly, with control, and with minimal friction. Therefore, a very fine lubricating talc is used in preference to a lotion, which is too slippery to allow the necessary slowness and control. Normal talcs (even baby powders) usually are not fine enough to allow really precise work. It should be obvious that this massage cannot be performed through clothes or with jewelry either on those areas being massaged or on therapists’ hands; otherwise, therapists’ senses of touch and of the pressures that they exert can be affected badly.

Clearing the body reservoirs and limbs. The larger lymphatics and nodes of the trunk form a "reservoir" into which the lymphatics of the limb drain. Therefore, the trunk is cleared first to create an empty space into which the lymph from the affected limbs can be emptied easily (it is useless trying to push fluid into a system that is full already). Once this is done, the lymph from the limbs is moved into the reservoirs and on to the previously cleared nodes. If lymph is to be taken from a limb and across the adjacent lymphotome to a normally draining one, then the normal lymphotome is cleared first, then the one adjacent to the limb, and finally the limb itself.

Nodal massage. The lymph nodes are very fine filters distributed along the large collecting lymphatics. Although they are situated throughout the body, they are also clustered at the major points of drainage of both limb and trunk lymphotomes. Because the nodes have 100 times the resistance of the lymph trunks, it is vital to empty these so that they can fill with new lymph. They must be cleared and recleared constantly.

Lymph node massage is performed with the tips of two or three fingers. These are placed over the nodes, and pressure is applied like a gentle "scoop" in the direction of further flow from them. The fingers do not move over the skin; rather, they apply pressure during the scoop and release it, before repeating this several times. It is a slow, deep, but gentle movement. In some areas, e.g., over the deltoid-pectoral ("cephalic") nodes, it could be described as a "stationary circle."

The "strokes." This is a light stroking movement over the skin. It is used over the lymphotomes toward previously cleared nodes. This is done with the palm of the hand and the fingers, which are either flat or curved to fit the area being treated. Sometimes, the area is so small that only the distal parts of the fingers can be used.

Relatively small areas are cleared at a time. Therefore, large lymphotomes must be cleared in sections, starting with areas closest to these nodes. When sections that are more distal are reached, these short strokes become longer.

One hand follows after the other to keep the lymph always moving in the desired direction to prevent the possibility of backflow. If therapists position both themselves and their hands correctly, then their fingertips will always end in exactly the correct position to massage the nodes after a few short or longer strokes.

Although mainly short strokes are used, they are followed by longer strokes if the drainage is being

taken to nodes at a distance. However, it is the slow work across the watersheds and the continual reclearing of the more proximal areas of the trunk drainage that are most valuable. The whole aim, as emphasized above, are to open new drainage pathways across the watershed through an enlargement of the superficial lymphatic drainage paths and to increase the drainage of the adjacent normal lymphotome through its normal lymphatic system. To do this, half of the deep collaterals crossing the watershed must have their normal direction of flow reversed despite the direction of their valves, and this involves much slow work. The pressure of the "stroke" may be increased slightly as the hand passes over a watershed.

Watersheds. Work over the watersheds is done with a deeper pressure. The ulnar edge of the hand and fifth finger or the widely extended forefinger and thumb move toward and over the watershed in an infinitesimal amount at a time. A constant pressure in the desired direction of lymph flow is maintained throughout.

Flow across watersheds must be enhanced both anteriorly and posteriorly and is performed only after the normally draining lymphotomes have been cleared.

Softening of fibrotic scar tissue. In softening scar tissue the thumbs are often used to break down fibrotic tissues. The pressure is much deeper and is always in the direction of desired lymph flow.

Clearance of deep truncal areas. Deep thoracic clearance can be achieved by a breathing exercise with the patient in a supine position. The patient inhales. On exhalation, the shoulders are "hunched" forward. If it is possible for the patient, the head also may be lifted and the chin pushed forward toward the sternum at the same time.

Deep abdominal clearance during clearance of the ipsilateral lymphotome, when appropriate, also can be achieved by a breathing exercise with externally applied pressure of the therapist's hands to aid with the creation of abdominal pressure (there are situations in which this is contraindicated). Other deeper abdominal work may be performed by a well-trained therapist that will aid in the clearance of this region and create a larger reservoir for drainage from the thoracic quadrant.

Massage sequence. It is essential to perform the massage in an ordered manner to achieve good results, with one hand following the other to keep lymph flowing in the required direction. First, the lymph

nodes of the lymphotomes adjacent to the lymphotome adjoining the lymphedematous limb are cleared. The lymphotomes that drain into these nodes are then emptied. The collateral drainage across the watershed separating these from that adjoining the lymphedematous limb is enhanced by very slow work over these areas. Only then is the lymphotome adjacent to the affected limb cleared across the watersheds to the previously cleared lymphotomes and nodes. Having achieved a full trunk clearance both anteriorly and posteriorly, it is possible to start on the most proximal part of the affected limb and to work gradually, after clearance of each section, to the distal regions.

However, it is *vital* that the reservoirs be reemptied whenever they become full. A self-aware patient may feel the nodes that drain their limb becoming full; they feel a dull ache. If this happens, then the more proximal reservoirs must be emptied again. In any case, the reservoirs toward which one is working should be emptied many times during a treatment, particularly the nodes.

Massage on nodes or deep vessels that are overloaded may cause dermal backflow. This can be dealt with by further superficial clearances.

It must be remembered that the four lymphotomes of the trunk each include all of the thoracic, or abdominal, surface of the trunk from the anterior midline to the posterior midline. However, usually, only the anterior and lateral or the posterior and lateral parts of them can be worked at any one time.

Usually, most of the treatment time will be spent on the trunk. For example, if the massage part of a session takes 90 minutes, then the first 60 minutes usually are spent on the trunk alone. As the treatment course proceeds, a longer time may be spent on the affected limb.

It should be pointed out that in a unilateral mastectomy, drainage can be taken from the thoracic quadrant and limb of the affected side to both the contralateral thoracic quadrant and the ipsilateral abdominal quadrant. However, in the case of a bilateral mastectomy, drainage should always be taken to the ipsilateral abdominal quadrant only. Scar lines or adhesions from radiotherapy damage from either of the above operations or from other, totally unrelated operations will also determine the pathways that are available for use.

The therapist must realize that these are only guides for treatment pathways and not fixed "recipes." Special attention may need to be paid to particular areas, e.g., a lymphedematous breast or lymphedema in the thoracic area immediately inferior to the axillary area, that manifests as a "bulge." Each patient has

their own individual problems, and the therapist must think and plan the treatment protocols accordingly.

Compression Bandages and Garments

Compression bandages are an essential part of the physical therapy of lymphedema to maintain the reductions achieved. Low-elastic (low-stretch) bandages are used to provide compression during the treatment of lymphedema. Compression bandages cause a mild increase in the total tissue pressure,³¹⁻³³ and, with exercise, they promote a variation in total tissue pressure³⁴⁻³⁶ that will increase lymphatic drainage by 1) increasing uptake by initial lymphatics and 2) increasing pumping by the lymphangions.

They are particularly necessary in lymphedema, because a feature of this disease is the loss of the elastic fibers from the tissues. They perform a similar function to elevating the limb, reducing the hydrostatic pressure gradient from blood to the tissues and increasing that along the lymphatic trunks. They also increase the gradient from the tissues to the initial lymphatics. Their use alone increases lymph flow with exercise and can reduce lymphedema. Graded compression, with greater compression distally and lesser proximally, is necessary. A low-stretch bandage plus muscle action will achieve this. It also prevents reflux of fluid back to the precleared, interstitial tissues and prevents further stagnation at the site of the initial lymphatics, so that they are not again overloaded. In the massage part of the treatment phase, this is extremely important. However, to maintain the result obtained by CPT, the graded compression plus exercise must continue afterward and be an integral part of the ongoing treatment.

It is very important to distinguish between *elastic* (high-stretch) and *low-elastic* (low-stretch) bandages. Low-stretch bandages are used for compression bandaging. Elastic bandages have a *high resting pressure* but a *low working pressure*. Not only are they very uncomfortable when the limb is at rest, but they stretch readily when muscles contract—hardly raising total tissue pressure and, thus, lymphatic pumping, at all. *Low-elastic* bandages have a *low resting pressure* and a *high working pressure*. Thus, they supply a comfortable amount of support to a relaxed limb but increase the total tissue pressure considerably when the muscle contract (Fig. 2). The lymphatics are compressed between the muscle and the bandage, causing them to pump. The importance of low-stretch compression was demonstrated by Partsch and Stemmer.³⁷⁻³⁹

The lymphatics will pump only when they are compressed (by muscular contraction, massage, or other form of pressure) against something solid and

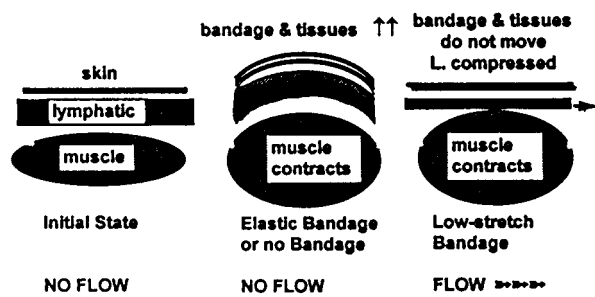


FIGURE 2. This demonstrates the importance of low-stretch bandages for pumping by lymphatics during muscle contraction. On the left is a relaxed muscle with lymphedema between it and the skin. The lymphatics lie in this area. In the center, the muscle has contracted, but the compression garment is either too elastic or nonexistent. The subcutaneous tissue simply moves away from the muscle, there is no compression and no lymphatic pumping. In the right, the muscle compresses the dilated lymphatics between it and a low-elastic compression garment or bandage. This makes the lymphatics pump, and the lymph flows on to the more proximal lymphatics.

unyielding; elastic bandages give way and do not compress the lymphatics, which then do not pump. A bandage with low elasticity (low-stretch) causes a high pressure within the limb when a muscle contracts (the *working pressure*), thus compressing the lymphatics. The *resting pressure*, however, is low [i.e., there is less pressure when the muscles are relaxed than would be the case with an elastic (high-stretch) bandage]; thus, the lymphatics can fill more readily.

During a course of therapy, bandages allow one to reshape a limb much better than garments because of the opportunity to insert various paddings. The bandages should be applied as firmly as is bearable over padding. The padding prevents bandage indentations in the skin and may be thickened to distribute pressure evenly over concave regions.⁸

The radius of curvature is important, e.g., at the sides of the hands, the radius of curvature is much smaller than that of the dorsum of the hand. A single turn of bandage will exert greater pressure where the radius is smaller and far less pressure where it is larger—often just where such increased pressure is most needed. This must be compensated for by extra padding.

The application of multilayer bandaging.

The bandages themselves must be applied with a greater pressure at the distal end of the limb, gradually reducing the pressure toward the proximal end. However, this is achieved by the number of layers and overlap of the bandages. It is *not* done by applying the bandages more tightly at the distal part of the limb. During treatment, a good rule of thumb is that the

bandage is applied as tightly as the patient can stand and is comfortable with. If bandages do become tight during the night and pain is not relieved by exercise, the therapist may need to attend and alter them. Fingers are bandaged first, before padding or outer bandaging are commenced.

To obtain an even pressure and as a safety measure to prevent chafing, a fairly low-density foam padding should be used. A “padding” bandage supplements this and evens out the radius of the limb as well as protecting it, before the low-stretch outer bandage is applied. The skin is protected by a washable gauze sleeve, which is changed daily. The padding is used over this (both foam and cotton padding bandages) primarily for protection of the limb against chafing and pressure points. Padding may then be built up as treatment proceeds, and different types of denser foam may be used to make special pads for the softening of fibrotic areas and for reshaping the limb.⁸

A change in bandage width is indicated as the circumference of the limb increases. The number and width of bandages used varies, of course, from patient to patient. The number of bandages needed depends greatly on the pressure of application and also on the particular bandage technique used.

A bandaged limb should feel comfortable. Although flexion at the joints is somewhat restricted, it should be possible for the patient to perform the necessary exercises.

Pressure garments for lymphedema.

Once a reduction of a lymphedematous limb has been achieved, pressure garments^{8,49} are essential if the fluid is not to rapidly refill the empty spaces. These cannot be used during the course of the therapy, because the size of the limb is changing so rapidly. Garments must be graded, with the pressure greater distally than proximally.

Availability of the garment is almost as important as efficacy. There is no point in treating a patient by physical therapy and then having to wait weeks for a suitable garment to arrive. Patients often are *not* able to bandage themselves as the clinic does (especially postmastectomy patients). In fact, often, it is hard for them to put on a pressure garment. This means that the choice of bandages and sleeves depends very greatly on good suppliers. If the garment has to be custom made, then, obviously, it is helpful to have a local manufacturer who can do any necessary fine alterations on the spot.

Once a therapist is experienced, they should find that almost all of the reduction occurs in the first 7–10 days, except in complicated cases. When they are confident of this, it means that a suitable fitting garment

can be ordered at this point if a made-to-measure garment is required. For this, it is essential that the measurement of the patient in the clinic or by a supplier is done absolutely correctly. Mistakes can be made, but it should not be the patient who has to bear that cost. Measure for a sleeve after a treatment session.

Custom-made garments will not be appropriate for the patient whose condition has not stabilized. Measurements taken on the patient whose edema is fluctuating will not provide accurate information for a well fitting garment. In these instances, or if a patient's therapy has to be delayed, it may be possible to choose a standard compression garment, because these can be fitted at once and monitored for suitability. A custom-made garment, when the measurement for this and the garment supplied are both absolutely correct, invariably is more comfortable. However, standard compression garments are less expensive than a custom-made garment, so this makes them an attractive choice. It is very important, however, to identify those situations in which a standard garment may not be appropriate and may in fact be contraindicated. This is necessary 1) for patients whose circumference measurements show extreme deviations against measurement tables for standard garments (this may result in a tourniquet effect in tight areas and/or a pooling of lymph in loose areas); 2) for patients whose length measurements vary greatly from the average; 3) for awkwardly shaped limbs or deformity; 4) where a nonstandard style is required; and 5) where a nonstandard compression gradient is required.

When choosing a compression garment, the issues of style, material, and compliance also must be taken into consideration. The style of garment will depend on such factors as location of condition (and the need to avoid pooling of fluid either distal or proximal to the garment), age, independence and dexterity of the patient, their life style (active, sedentary, living alone), and work conditions. Environmental factors, such as climate, will influence the wearing of the garment. Suspected poor compliance and/or poor hygiene need to be addressed.

The patient's comfort and, thus, their compliance is of great importance for the maintenance of the progress made during therapy. Much depends on the fit of the garment and the material of which it is made. Some patients have allergy problems to synthetic materials, and a cotton coating of the elastic fibers is then very important; others have the reverse problem. Some garments "breathe" more than others. Some have an inner soft knit. Others can be lined. Anything that gives greater comfort will aid compliance.

A number of patients need gloves or gauntlets. The gauntlet variety (i.e., attached to and part of the sleeve) are preferable, in that they reduce the risk of a pressure band at the overlap. If the lymphedema is severe, particularly in the upper arm, and a good reduction is obtained during treatment, then care must be taken not to prescribe a high-compression sleeve (greater than 45 mm Hg) without an accompanying hand piece. A sleeve to the wrist alone is likely to result in triggering lymphedema of the hand and fingers. However, if the lymphedema is treated in the earlier stages and there is no problem with the hand, then a sleeve from the wrist up is preferable.

One needs to be wary of a sleeve that stops too short of the proximal end of the limb or that causes a pressure band at that (or any other) point. This will *reduce* lymphatic drainage as well as causing a band of fibrotic tissues to form that, later, will also reduce drainage when it contracts.

Many styles and makes are available. When properly prescribed, they are almost equally effective. However, good service and availability from the manufacturer or suppliers may determine which garments the therapist may find most satisfactory for use.

Exercises for Lymphedema

Exercises are an essential part of the CPT program both during treatment and in the maintenance phase. They must be specially designed for patients with lymphedema to be maximally effective. The principle of the exercises that I suggest is to achieve clearance of the trunk and nodes first, so that the affected arm has somewhere to drain to, and then to help clear the arm. They are combined with a certain amount of self-massage, as the program proceeds. The design of these exercises mimics the pattern and massage clearance during CPT.⁴

The exercises are intended as an adjunct to the treatment of lymphedema by CPT. It must be emphasized that they are not intended as a complete treatment of lymphedema by themselves but merely as a most useful addition to existing methods. However, they should also benefit sufferers from lymphedema who, for one reason or another, are unable to attend a clinic. Their effectiveness has been demonstrated not only in improving the results of CPT but in maintaining them.^{42,43} To be effective, the exercises must be performed while wearing the appropriate compressive bandaging or compression sleeves or stockings.

Exercises should be taught to the patient when they first start a treatment course. They should be modified to suit each individual patient. Once the patient is competent and able to perform them correctly, it is preferable that they are done at that part of

the day furthest removed from their treatment session, because they will act as a separate "minimassage" and an enhancement of lymphatic clearance. The exercises are designed carefully to be followed in sequence. They have five functions: 1) The first exercises empty the more central lymph reservoirs (the nodes and the proximal lymph trunks). Particular attention is paid to emptying adjacent, normal lymphotomes. This provides space into which the lymph from the periphery may flow (otherwise, the very high hydraulic resistance in the nodes reduces the flow of lymph). 2) The remainder of the exercises make any surviving lymphatics work more efficiently. Despite the importance of contractions by the walls of collecting lymphatics, lymph flow is aided considerably by varying total tissue pressure, like what is achieved by the compression of these vessels by contracting muscles against the surrounding fibrous tissues. The initial lymphatics pump *only* by virtue of such varying total tissue pressure. Such variations also greatly assist in the passage of fluid through the interstitial tissue. 3) Exercises help to mobilize joints and swollen areas. 4) Exercises strengthen the muscles of the limb and help avoid muscle wasting, which can be a feature of lymphedema. 5) Exercises are combined with a small amount of self-massage to aid in emptying nodes and the lymphotomes of the trunk.

Adapting the exercises.

Patients, especially elderly, obese, or postmastectomy patients, have varying degrees of movement in their joints. A postmastectomy patient often needs to be encouraged and to have special exercises designed to increase the range of movement in their shoulder joint in order to stop the skin and fascia of the axilla from shrinking. Ideally, these exercises should be taught and supervised after the mastectomy or lumpectomy and radiotherapy (i.e., before there is any suggestion of lymphedema) to prevent deformity and tissue shrinkage. If these have not been done adequately, then mobilization exercises must be taught first before exercises for lymphedema can be performed easily.

Some exercises are difficult, and their correct performance will take some time to achieve. Do not let the patient be disheartened if, at first, the result does not seem quite correct and they cannot feel the muscle or limb section in isolation. This will come with practice.

The exercises need to be modified if a patient has had bilateral mastectomies. Any exercises that push lymph to the opposite side of the chest should be omitted. More time should be spent on those that clear the pelvis on the ipsilateral side. Time should be allowed for nodal and superficial self-massage. This

should be used to clear the superficial inguinal nodes, the lower abdominal quadrants, and, last, the thoracic quadrants across the abdomen to the inguinal nodes. For maximum effect, when possible, these exercises should be performed with the affected limb elevated.

The amount of exercise that should be performed on a daily basis also must take into account the patient's life style and how much exercise they do in the course of their daily work. On days of heavy and unusual work, therapeutic exercises should be lessened accordingly. In fact, a better result may be achieved by doing the trunk clearance exercises only and then lying and resting with the limb elevated for 30 minutes, with periodic flexion and extension of the hand.

Exercise and sport

A patient with lymphedema should avoid exercises or sports that jar the affected limb(s). Tennis may be possible, particularly if a lymphedema of the arm is on the nondominant side. Although caution should be exercised, we do not suggest that a patient give up something that they enjoy doing. If the limb aches after the exercise or sport of their choice, then they should do less of it. Some exercise can help lymphedema, e.g., swimming (but, again, not too much) and scuba diving. Any exercise that a patient finds beneficial is indeed indicated for them; it may not necessarily be of benefit to other patients.

Results of Treatment

The actual results of any form of therapy are most important. These are not only the results immediately after treatment finishes but months to years later. It is clear that the results of CPT are very good indeed—better and faster than any other method of treating lymphedema. However, it must be emphasized again and again that good results depend on a well-trained and careful therapist and on patient compliance after the course. Therefore, a brief summary follows of the results that Casley-Smith-trained therapists have obtained, covering the first course of treatment and ranging from a 1-year to a 3-year follow-up. Informed consent was obtained for the trials described below.

The Adelaide Lymphedema Clinic achieved an average reduction of 64% of the edema over a month's course of treatment for the first consecutive 78 arms to pass through the clinic.⁴⁴ The reduction achieved depended on the grade of lymphedema (how much excess fibrosis) and patient compliance. Only a few patients had been treated for more than 1 year, so not so many long term results were available. The results are summarized in Figure 3. Arms were all unilateral. There were very significant differences between the

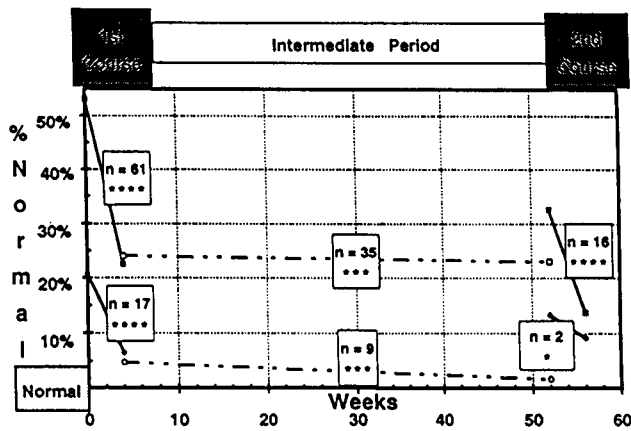


FIGURE 3. Mean values for all arm patients over 13 months. The upper set of lines (squares) refer to Grade 2 lymphedema, and the lower lines (circles) refer to Grade 1. The results of the first and second courses are shown by solid lines, and results of the intermediate periods are shown by dashed lines. Numbers of patients and significance are shown for each period. Because there were fewer patients in each succeeding group, their initial values are different from the final values from the preceding group. It can be seen that well over half of the initial edema was lost in the first course, that this loss not only was maintained but improved slightly during the intermediate period, and that half of the remaining edema was lost during the second course.

grades. Grade 2 lost more liters of edema, but grade 1 lost a greater percentage of edema.

In the first 4-week course of CPT in the arms, the mean grade 1 was reduced from 121% of normal to 107% (a mean reduction of 68%). Grade 2 was reduced from 153% to 123% (a mean reduction of edema of 57%). Over the next year, 44 patients were available to follow. There was a further (nonsignificant) decrease. Another 4-week course in 18 patients resulted in very significant reductions in the residual edema. Even in grade 2 lymphedema in the arms, about 60% of the edema was removed in the first course, and about 60% of the remainder was removed in the second course.

In another trial, the treatment results of over 600 limbs from 22 different therapists^{45,46} were analyzed. This was an open trial, but it was the only way this information could be obtained. However, only objective measurements were used, except for patient compliance. Care was taken to obtain results of all patients treated by each therapist. Half of the data were from one clinic alone. No selection was made, and the results of all who received more than 3 days of treatment were included. The effect of CPT and that of a number of factors—exercise, benzopyrones, a mercury pump (Palmer 900) that was used with a few patients, and patient compliance with garments—were able to be analyzed by multivariate analysis and are summarized in Figure 4–6.

For many years in Australia, many patients have used benzopyrones either alone or as an adjunct to CPT treatment. This paper is not concerned with these trials. However, because, in some trials, both oral and topical forms of these drugs have been an integral part of the treatment, their action must be understood. Benzopyrone drugs reduce lymphedema and elephantiasis. They make the body’s macrophages lyse more of the excess protein in the tissues than they normally do. With the protein gone, water can return through the venous capillaries and any functioning lymphatics. The excess fibrosis is removed, and there are far fewer attacks of infection. Hence, they help in all high-protein edemas, including lymphedema.^{47–52} Perhaps one of their greater benefits is with patients who may lack compliance after a treatment course, especially regarding exercise. They aid in a continual reduction that would not occur otherwise.

CPT offers great reductions for lymphedema of all grades (including elephantiasis). Older patients improve very significantly more than the younger patients, grade 2 patients improve more than grade 1 patients, and arms improve more than legs. Sex, duration, and cause of lymphedema (including primary lymphedema) make no difference.

However, these reductions are made much greater if benzopyrones are used in association with CPT: oral benzopyrones for at least 3 months before the course of CPT, during, and after it, and topical benzopyrones during and after the course. Reductions also are improved greatly if the patients perform the specifically designed exercises before, during, and after the course. Together, these adjuncts can produce good results even with less skilled therapists; but the more skill, the better the results.

Maintenance of the reduction is also greatly improved by both the oral benzopyrones and the exercises. The compliance of the patient (partly reflected in the care of their compression garments) also is very important in maintaining the reduction.

Although a Mercury compression device, Palmer 900, assisted reductions for the first course, it did not assist in subsequent courses. Air pumps did not assist at all; indeed, their use was associated with worse results, but this may have been from therapists becoming reliant on these rather than on their own efforts.

The results of the best therapists, of course, are better than those of the average therapist. The therapists from Lymphedema Therapy not only had very intensive and longer training than some of the others but have been able to spend the time necessary with each patient to produce the best results. It is noteworthy that none of their patients needed a follow-up

FIGURE 4. Reduction in volume during the first course of complex physical therapy (CPT; 618 limbs) expressed as a percentage of the limb volume at the start of the course. Y axis, volume reduction; X axis, time; BP, benzopyrones. Grade 1 = pitting edema; Grade 2 = non-pitting edema.

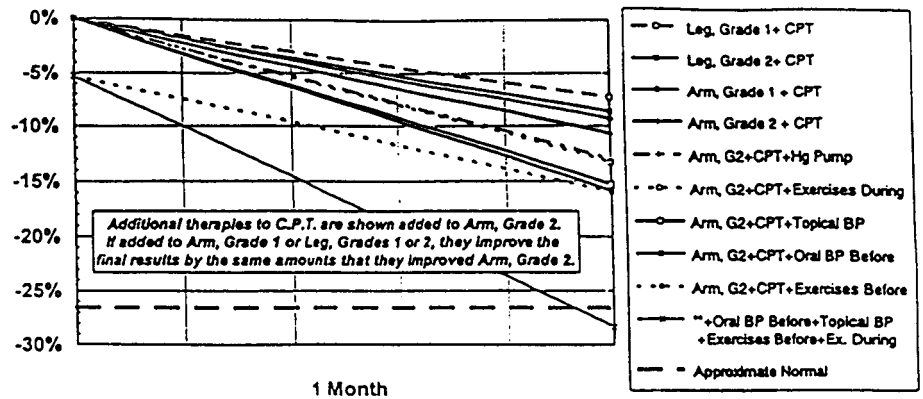


FIGURE 5. Change in volume during the intermediate period (219 limbs) expressed as a percentage of the limb volume at the start of this period. N.S.D.; no significant difference.

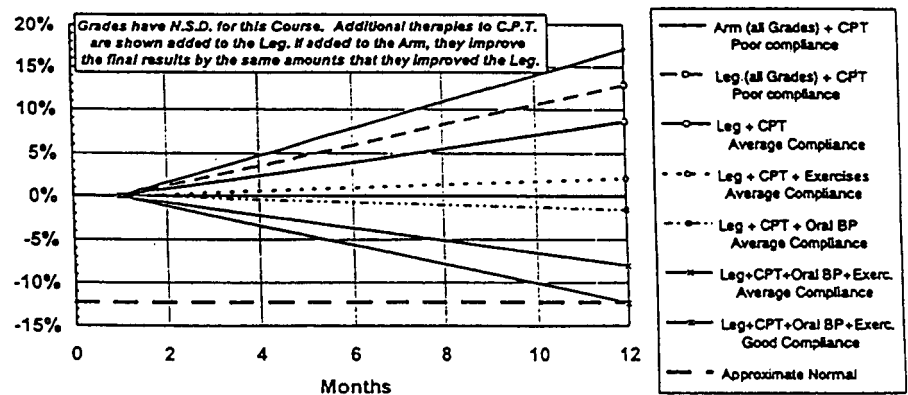
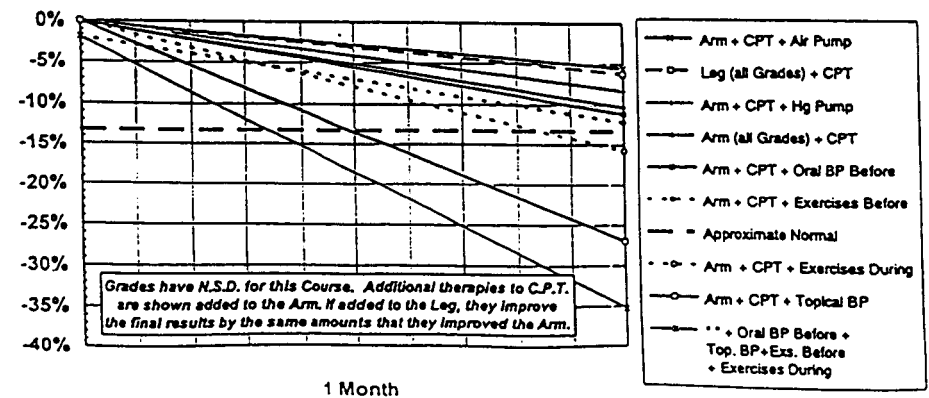


FIGURE 6. Reduction in volume during the second course of CPT (84 limbs) expressed as a percentage of the limb volume at the start of the course.



treatment and that the degree of good patient compliance was exceptionally high.

Lymphedema Therapy reported 16 arms with a mean reduction of 73%. After 1 year, they had 80% reductions with no further treatment.⁵² A later report⁵³ gives the results of 58 consecutive patients; 56 single arms and 2 bilateral arms. After the first course, reductions were 63% for the unilateral arms. After 3 years, with no further courses, the means for unilateral arms were 64%. Compliance was estimated from the percentage of time the patient wore a compression garment, how they maintained it, and their adherence

to performing the Lymphoedema Association of Australia exercises.⁴¹ For the unilateral arms, patients who were 100% compliant increased their mean reductions from 63% to 79% over the 3 years; the noncompliant patients had their reductions worsened from 63% to 43%. This was highly significant (Figs. 7, 8). All of these results are better than those of the average therapist.

Efficacy of Treatment versus Costs of Treatment

Cost efficacy of CPT compared with other modes of therapy is necessary to consider. For example, many believe that pumps must be cheaper. Both public and

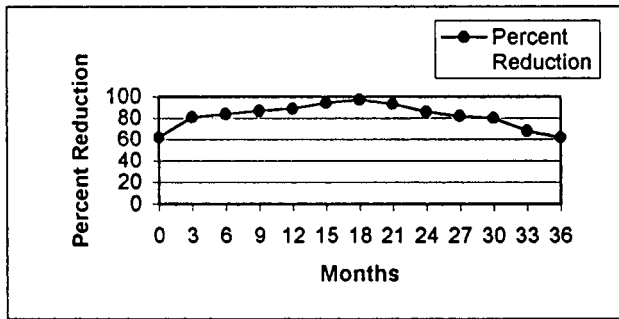


FIGURE 7. Persistence of lymphedema reduction in patients with one lymphedematous arm.

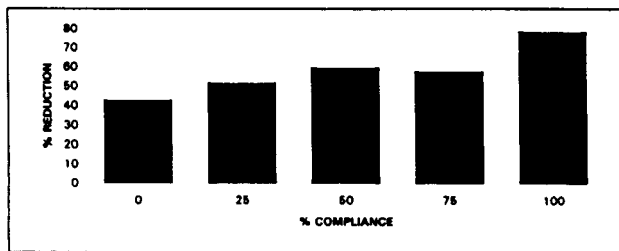


FIGURE 8. Effect of compliance: Reduction in lymphedema in patients with one lymphedematous arm according to the degree of compliance.

private health insurances will often cover the cost of surgery for lymphedema. However, when all factors are taken into consideration, the costs of the above are neither cheaper (and, in the case of surgery, are very much more expensive) than the cost of CPT, and the results are very poor if not negative by comparison.⁵⁴

Whereas the actual costs involved can be calculated, what are impossible to estimate are both public and private costs. These may include having to support a person who becomes disabled, is not able to work or contribute as a taxpayer, or may need disability compensation and perhaps other costly aids to be able to function at all. To this must be added not only the risk, but the cost, of more frequent infections and threat to life in some instances.

The facts that good treatment with CPT can alleviate these problems and that the cost is far less prohibitive than other, unsuccessful, treatments, which may be repeated over many years and, in many cases, may be worse than no treatment at all, must be appreciated and acted upon. The cost of the course of CPT was based on 4 weeks of treatment, and costs of bandages and garments were included (Fig. 9).

These results are expressed only in terms of percentage reductions, because they are measurable. What have not been measured (at least so far) are improvements in the quality of the patients' lives. However, such consideration are far more important

to the patient (and to a responsible doctor or therapist) than mere percentage points.

Although what is affordable (for a patient or a community) ultimately will limit what can be done, some place a higher value than others on returning as closely as possible to normalcy. Thus, again, the individual patient's needs, desires, and geographic and economic circumstances will have to dictate what is done for (and to) them. For many, a treatment far below the "best possible one" is all that can possibly be offered. However, the most important considerations are still whether therapy is available from a well trained therapist for the specific patient, whether they can afford it, and whether they accept the regime and are compliant with it.

Case Histories

The following examples of postmastectomy lymphedema illustrate a number of the different points and provide an immediacy that means and standard errors, however important, cannot convey.

Patient 1

Patient 1 was a 78-year-old woman with postmastectomy lymphedema of the left arm of 17 years' duration. Radiotherapy had caused damage, and the humeral head was showing slow ischemic necrosis. There was also degeneration of the rotator cuff and damage to the distal end of the humerus. She had a greatly restricted range of movement at both shoulder and elbow; for this reason, both the massage and the exercises had to be greatly modified. She could not lie on her stomach; therefore, much of the massage time was spent clearing the anterior parts of the abdominal lymphotomes. There were many scars on the forearm due to the removal of squamous-cell carcinomas (one area measured 1 × 1.5 cm). These gradually disappeared during treatment with the application of coumarin ointment. The skin was hot, dry, and fragile; it was treated with mineral-oil washes and moisturizers (Hamilton) and with coumarin ointment and powder.

The patient was treated only for 3 weeks because of her age, but the edema was reduced by 55% (Figs. 10–12). She was fitted with a standard Elvarex (Beiersdorf) sleeve. She continued to take oral coumarin and to perform her exercises. There were further reductions in her arm. After 5 months, she could perform normal activities of daily living. After 18 months, she returned for a 2-week course of CPT, achieved a total of 90% reduction in edema (Figs. 13, 14), and is no longer "the lady with the big arm."

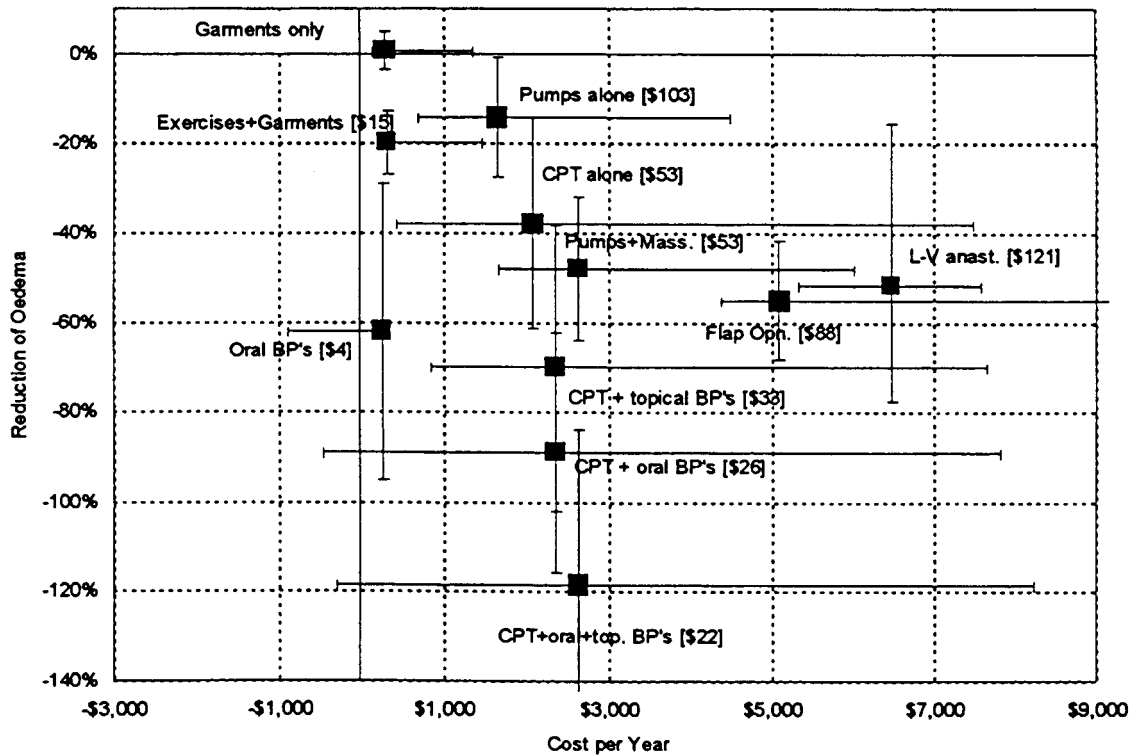


FIGURE 9. Chart of lymphedematous arms showing the percentage reductions in edema over the year and the annual cost of each therapy in U.S. dollars. The reductions are adjusted to allow for the increases of lymphedema that occur if it remains untreated. Average values are shown (square) at the center of a cross formed by the ranges of the best results and the worst results of each for both the percentages and the costs. Labels are as close as practical to each point but, in some instances, had to be somewhat removed onto one of the range bars. Following each label is the average cost per 1% reduction in edema per year in brackets. It should be noted that, when benzopyrones (BP's) are used, some of the ranges include negative costs. This is because the costs associated with most of the secondary acute infections are lower, resulting in a total saving of money.

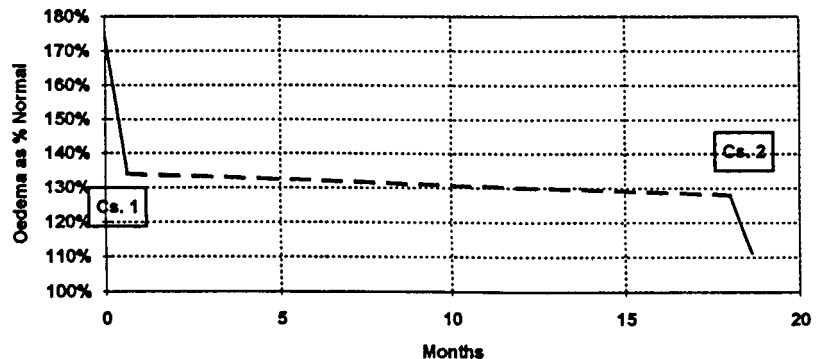


FIGURE 10. Grade 2 postmastectomy lymphedema of 17 years duration (78 years old). The y axis gives the percentage of swelling compared with the normal arm. CPT and oral and topical benzopyrones were used, and exercises were performed. Each course of CPT is shown as a solid line, and the intermediate period is shown as a dashed line. The actual courses are noted by Cs.

Patient 2

An 84-year-old woman had a bilateral mastectomy and axillary dissection and radiotherapy 25 years earlier. Over the next 20 years, there was a gradual increase in edema. She had a history of multiple episodes of cellulitis. She had used a pump for 2 years prior to treatment. The patient's right upper extremity and hand were completely nonfunctional, and she required assistance with all activities of daily living.

On presentation (Figs. 15, 16), she had moderate S.A.I. (secondary acute infection) and was given antibiotics. After this subsided, she was treated with CPT. Initially, the mean circumferential difference was 18 cm greater than the normal arm. After a 3-week course, this was reduced to 4.2 cm, a 77% reduction (Figs. 17, 18). She wore a 20 mm Hg compression garment and had an 83% reduction after 1 month, an 86% reduction at 3 months, and an 89% reduction at 5



FIGURE 11. Before the first course, note the condition of the skin. Movement was very limited (courtesy of Sydney Lymphoedema practice, P. Dyson and S. Boyce)

FIGURE 12. After the first course, note the reduction and improvement of the skin.

FIGURE 13. Before the second course, the skin and movement were much improved.

FIGURE 14. After the second course, the arm was almost normal, and the skin was excellent.

months (Figs. 19, 20). Her most recent measurement showed a 92% reduction. This again shows how well lymphedema resolves in the elderly.

Relation of CPT to Other Manual Therapies

There are many similarities but also some major differences between the Casley-Smith method and the physical methods of other schools. In each case, the various physical regimes, as mentioned above, are based on the same underlying anatomic, physiologic, and pathologic knowledge. Techniques of massage, bandaging and padding, exercise, and drug therapy vary between them, although some of the techniques are similar. There have been many variations of the Vodder method, particularly in Europe. All of these methods are updated and adapted continually.

The various methods (at least as they are at present) should not all be looked upon as necessarily producing the same results. Proof of their efficacy lies ultimately in their *published* results. There are also many who say that they practice “CPT” “MLD” or “lymphatic drainage” but have very dubious qualifications. Results they produce must not be taken as the equivalent of a well-trained therapist in any of the regimens. The Casley-Smith method of CPT basically uses massage techniques that differ from any of the

other methods, although, of course, some aspects are the same. The work over the watershed areas varies and is more intensive and concentrated. The exercises for CPT were developed separately and were designed specifically to mimic the sequences of the massage. The combination of physical methods with the benzopyrones was also instigated.

CONCLUSIONS

It has been proven that exercises and benzopyrones combined with CPT can play very important and statistically highly significant roles, both during the course of treatment and for further reduction after treatment. It is clear that, with postmastectomy lymphedema, the earlier the patient receives treatment, the better the prognosis, and the less the overall cost involved both in monetary terms and in quality of life. It is possible that with better diagnostic methods, e.g., further advances in lymphoscintigraphy, we will be able to predict more accurately those people with limbs at risk of developing lymphedema.

However, until that time, a few prophylactic measures should be taken into account to prevent its onset.⁴¹ These include the avoidance of any trauma, e.g., cuts or abrasions, sunburn, etc.; the overloading of the limb, e.g., carrying heavy loads; blood-pressure cuffs



FIGURES 15–20. A large, postmastectomy lymphedema in an elderly woman. Figures 15 and 16 (top row) show the initial state of the patient. Figures 17 and 18 (middle row) show the patient after the course of CPT, and Figures 19 and 20 (bottom row) show the patient after 1 year (courtesy of Lymphedema Therapy, NY, Boris, Lasinski, and Weindorf).

used on the limb at risk. Spotless cleanliness; keeping the skin moist and supple; immediate treatment of any infection; and, for long flights (in which the cabin pressure is lower), prophylactic compression are essential.⁵⁵ On the positive side, a person should be encouraged to lead as normal a life as possible. Prevention of lymphedema should be of foremost priority.

REFERENCES

1. Winiwarter F. Das Elephantiasis "Deutsche Chirurgie." Stuttgart: Enke, 1892:23.
2. Wittlinger H, Wittlinger G. Textbook of Dr. Vodder's manual lymph drainage. Vol 1, basic course, 3rd rev. Heidelberg: Haug, 1982.
3. Földi M, Kubik S. Lehrbuch der Lymphologie für Mediziner und Physiotherapeute. Stuttgart: Fischer, 1989.

4. Földi M, Földi E. Komplexe physikalische entstauungstherapie des chronischen gliedmaßen lymphödems. *Folia Angiol* 1981;29:161–8.
5. Foldi E. Comprehensive lymphedema treatment center. *Lymphology* 1994;27:505–7.
6. Anon. The diagnosis and treatment of peripheral lymphedema. *Lymphology* 1995;28:113–7.
7. Foldi M. Treatment of lymphedema. *Lymphology* 1994;27:1–5.
8. Casley-Smith JR, Casley-Smith JR. Modern treatment of lymphoedema, 5th ed. Malvern: The Lymphoedema Association of Australia, 1997.
9. Casley-Smith JR, Casley-Smith JR. High protein, oedema and the benzo-pyrones. Sydney: Lippincott, 1986.
10. Leduc O, Dereppe H, Hoylaerts M, Renard M, Bernard R. Hemodynamic effects of pressotherapy. In: Progress in lymphology. XII Excerpta medica, International Congress series 887. Nishi M, Uchino S, Yabuki S, editors. Amsterdam: Elsevier, 1990:431–4.
11. Casley-Smith JR, Földi M, Ryan TJ, et al. Lymphedema. Summary of the 10th International Congress of Lymphology working group discussions and recommendations. Adelaide, Australia, August 10–17, 1985. *Lymphology* 1985;18:175–80.
12. Földi E. Prevention of dermatolymphangioadenitis by combined physiotherapy of the swollen arm after treatment for breast cancer. *Lymphology* 1996;29:48–9.
13. Okhuma M. Cellulitis seen in lymphoedema. In: Progress in Lymphology XII. Excerpta medica, International Congress series 887. Nishi M, Uchino S, Yabuki S, editors. Amsterdam: Elsevier, 1990:401–2.
14. Ohkuma M. Mycotic infection in lymphoedema. In: Progress in Lymphology XIII. Excerpta medica, International Congress series 994. Cluzan RV, Pecking AP, Lokiec FM, editors. Amsterdam; Elsevier, 1992:489–90.
15. Thiadens SRJ. A study of infection in 353 lymphedema patients and antibiotic therapy. In: Progress in Lymphology XIII. Excerpta medica, International Congress series 994. Cluzan RV, Pecking AP, Lokiec FM, editors. Amsterdam: Elsevier, 1992:477–8.
16. Olszewski WL, Jamal S, Dworzynski A, et al. Bacteriological studies of skin, tissue fluid and lymph in filarial lymphoedema. *Lymphology* 1994;27(Suppl):345–8.
17. Bedna K, Švestková S. Incidence rate of recurrent erysipelas in our lymphoedema patients. *Lymphology* 1994;27(Suppl):519–22.
18. Pecking A, Cluzan R, Desprez-Curely JP. Indirect lymphoscintigraphy in patients with limb edema. In: *Progress in Lymphology*, Heim LR, Braf ZF, Casley-Smith JR, Dumont AE, Yoffey JM, editors. Newburgh: Immunology Research Foundation 1984:201–8.
19. Casley-Smith JR, Björlin M. Some parameters affecting the removal of oedema by massage - mechanical or manual. In: Progress in Lymphology X. Casley-Smith JR, Piller NB, editors. Adelaide: University of Adelaide Press, 1985:182–4.
20. Derdeyn A, Aslam M, Pflug JJ. Manual lymph drainage—mode of action. *Lymphology* 1994;27(Suppl):527–9.
21. Hutzschenreuter P, Bruemmer H. Influence of complex decongesting therapy on positive interstitial pressure and on lymphgiomotor activity. In: Progress in Lymphology XI. Excerpta medica, International Congress series 779. Partsch H, editor. Amsterdam: Elsevier, 1988:557–60.
22. Franzeck UK, Herrig I, Costanzo U, Hofer HO, Bollinger A. Lymphatic capillary pressure and network extension in patients with lymphoedema before and after combined physical therapy [abstract]. *Eur J Lymphol* 1995;5:149.
23. Leduc O, Bourgeois P, Leduc A. Manual lymphatic drainage: scintigraphic demonstration of its efficacy on colloidal protein reabsorption. In: Progress in Lymphology XI. Excerpta medica, International Congress series 779. Partsch H, editor. Amsterdam: Elsevier, 1988a:551–4.
24. Casley-Smith JR. Endothelial permeability. II. The passage of particles through the lymphatic endothelium of normal and injured ears. *Br J Exp Pathol* 1965;46:25–49.
25. Leduc A, Bastin R, Bourgeois P. Lymphatic reabsorption of proteins and pressotherapies. In: Progress in Lymphology XI. Excerpta medica, International Congress series 779. Partsch H, editor. Amsterdam: Elsevier, 1988b:591–2.
26. Mortimer PS. Assessment of peripheral lymph flow before and after clinical intervention. In: Progress in Lymphology XII. Excerpta medica, International Congress series 887. Nishi M, Uchino S, Yabuki S, editors. Amsterdam: Elsevier, 1990:215–22.
27. Mortimer PS, Simmonds R, Rezvani M, et al. Measurement of skin lymph flow by an isotope clearance technique: reliability, reproducibility, effect of injection dynamics and lymph flow enhancement. *J Invest Dermatol* 1990;95:677–82.
28. Casley-Smith JR. Estimation of optimal massage pressure: is this possible? *Folia Angiol* 1981;29:154–6.
29. Elisšková M. Are peripheral lymphatics damaged by high pressure manual massage? *Lymphology* 1995;28:21–30.
30. Földi E. Massage and damage to lymphatics. *Lymphology* 1995;28:1–3.
31. Coleridge Smith PD, Scurr JH, Robinson KP. Optimum methods of limb compression following varicose vein surgery. *Phlebology* 1987;2:165–72.
32. Lawrence D, Kakkar VV. Graduated, static, external compression of the lower limb. *Br J Surg* 1980;67:119–21.
33. Leduc O, Klein P, Demaret P, Belgrado JP. Dynamic pressure variation under bandages with different stiffness. In: Vascular medicine, International Congress series 1018. Boccalon H, editor. Amsterdam: Elsevier, 1993:465–8.
34. Leduc O, Klein P, Demaret P, Belgrado J-P. Dynamic pressure variation under bandages with different stiffness. In: Vascular Medicine. International Congress series 1018. Boccalon H, editor. Amsterdam: Elsevier, 1993:465–8.
35. Leduc O, Peeters A, Bourgeois P. Bandages: scintigraphic demonstration of its efficacy on colloidal protein reabsorption during muscle activity. In: Progress in Lymphology XII. Excerpta medica, International Congress series 887. Nishi M, Uchino S, Yabuki S, editors. Amsterdam: Elsevier, 1990:421–3.
36. Olszewski WL, Engeset A. Vasomotoric function of lymphatics and lymph transport in limbs during massage and with elastic support. In: Progress in Lymphology XI. Excerpta medica, International Congress series 779. Partsch H, editor. Amsterdam: Elsevier, 1988:571–5.
37. Partsch H. Verbesserte förderleistung der wadenmuskelpumpe unter kompressionstrümpfen bei Varizen und venöser Insuffizienz. *Phlebol Proktol* 1978;7:58.
38. Partsch H. Do we need firm compression stocking exerting high pressure? *Vasa* 1984;13:52–7.
39. Stemmer R, Marescaux J, Furderer C. Compression treatment of the lower extremities particularly with compression stockings. *Dermatologist* 1980;31:355–65.
40. Hohlbaum GG, Milde L, Schitz R, Weber G. The medical compression stocking. Stuttgart: Schattauer, 1989.

41. Casley-Smith JR. Exercises for patients with lymphoedema of the arm and a guide to self-massage and hydrotherapy, 5th ed. Malvern. The Lymphoedema Association of Australia, 1998.
42. Swedborg I. Effectiveness of combined methods of physiotherapy for post-mastectomy lymphoedema. *Scand J Rehab Med* 1980;12:77-85.
43. Morgan RG, Casley-Smith JR, Mason MR, Casley-Smith JR. Complex physical therapy for the lymphoedematous arm. *Br J Hand Surg* 1992;17B:437-41.
44. Casley-Smith JR, Casley-Smith JR. Lymphoedema therapy in Australia, complex physical therapy and benzo-pyrones in over 600 limbs. *Lymphology* 1994;27(Suppl):622-6.
45. Casley-Smith JR, Casley-Smith JR. Lymphoedema therapy by complex physical therapy (C.P.T.), with and without oral and topical benzo-pyrones: what should therapist and patients expect? *Lymphology* 1996;29:76-82.
46. Casley-Smith JR, Piller NB, Morgan RG. Treatment of lymphoedema of the arms and legs with 5,6 benzo-a-pyrone. *N Engl J Med* 1993a;329:1158-63.
47. Clodius L, Piller NB. The conservative treatment of post mastectomy in patients with coumarin results in a marked continuous reduction in swelling. In: *Advances in Lymphology*. Bartos V, Davidson JW, editors. Prague: Avicenum, 1982:471-4.
48. Cluzan R, Pecking A. Benzopyrone (Lysedem) double blind crossing over study in patients with secondary upper limb edemas. In: *Progress in Lymphology XII*. Excerpta Medica, International Congress series 887. Nishi M, Uchino S, Yabuki S, editors. Amsterdam: Elsevier, 1990:453-4.
49. Desprez-Curely JP, Cluzan R, Pecking A. Benzopyrones and post mastectomy lymphoedemas. Double-blind trial placebo versus sustained release coumarin with trioxethylrutin (TER). In: *Progress in Lymphology X*. Casley-Smith JR, Piller NB, editors. Adelaide: University of Adelaide Press, 1985:156-8.
50. Piller NB, Clodius L. Clinical results of the effectiveness of Venalot in 103 postmastectomy lymphoedema patients: In: *Advances in Lymphology*. Bartos V, Davidson JW, editors. Prague: Avicenum, 1982:475-9.
51. Piller NB, Morgan RG, Casley-Smith JR. A double blind cross-over trial of O-(β -hydroxy-ethyl)-rutosides (benzo-pyrones) in the treatment of lymphoedema of the arms and legs. *Br J Plast Surg* 1988;41:20-7.
52. Boris M, Weindorf S, Lasinski B. Lymphedema reduction by noninvasive complex lymphedema therapy. *Oncology* 1994; 8:95-106.
53. Boris M, Weindorf S, Lasinski B. Persistence of lymphedema reduction after noninvasive complex lymphedema therapy. *Oncology* 1997;11:99-109.
54. Casley-Smith JR, Casley-Smith JR. The cost efficacy of various treatments for lymphoedema. *Lymphology* 1996;29:49-55.
55. Casley-Smith JR, Casley-Smith JR. Lymphoedema initiated by aircraft flights. *Aviat Space Environ Med* 1996;67:52-6.