6 The IPC-Plus Method of Improved Decongestion for Lymph Edemas

Martin Morand, Berlin

6.1 Introduction

In this chapter the IPC-Plus-Method is described, a newly developed, independent procedure for apparative intermittent pneumatic compression (IPC), leading to a significant improvement and extenstion of the effect when compared to the previously known IPC. It will be proposed as a new theraputive module in addition to manual lymph drainage (MLD) and complex physical decongestion therapy (CPE).

Ideally, initiating treatment using IPC should only be carried out by lymph drainage therapists and physicians who have experience with lymphology. They have adequate training in the actual modus of decongestion therapy (14). A thorough enlightenment of the patient is an absolute necessity. Instructions for self-treatment should not be given for medical products.

With patients who have lymphological edema disease, theraphy using MLD and KPE are considered the gold standard. Intially, a treatment is carried out on a five to six times per week basis. The time length of this so-called “phase one” of the CPE will be determined by the length and seriousness of the angiological edema illness. This phase is concluded by successfully providing the patient with flat-weave compression stockings. Proper measurements for such stockings (LCSV) are made during a largely edema-free situation (1). A further absolutely necesity within the CPE is the education of the often chronically ill patients, in the form of instructions for self-management. This time-intensive duty is usually carried out primarily by therapists trained in MLD/CPE. Full-day schooling is often carried out during one or more MLD treatment sessions. In many cases affectionate attitudes are of significant psychological benefit. In cases of numerous chronically ill patients, it takes a number of enlightening discussions before their necessary active participation can be achieved.

In the past studies have been made as to the effectiveness of having a CPE combined at the same time with a IPC. The results of these investigations suggest that there is no particular advantage to a directly combined CPE and IPC as compared to a CPE by itself (2, 19).

In Continuing Education courses in MLD/CPE, most of which are taken by by physical therapists or medical masseurs, there is so far no regular instruction in IPC given. And in any case, an outpatient physical therapy practice is not able to bill an insurance provider for an IPC treatment, because not only is it not listed in any official description of services as a replacement for MLD/CPE, this is even expressly forbidden (12).

At the 42nd Annual Conference of the German Society for Lymphology in 2018, eight departmental or leading physicians in lymphological specialty clinics took part in a podium discussion where they were specifically asked about including the use of IPC in their institutions. Their answers were inconsistent, ranging from refusal to partial acceptance. In Germany, the additive use of IPC as a supporting measure to MLD and CPE is primarily used in Maintenance Phase II of CPE. Patients with lymphological edema

diseases, particularly long-term, mostly use prescribeable control units with the associated inflateable sleeves, at home in self-management, adjuvant to MLD/CPE.

The author of this chapter is the head of a lymphological specialty physical therapy practice and has worked since 2014 on the constant improvement of the efficacy of IPC. He has determined that IPC in its traditional form is no doubt able bring about a fluid-draining effect, but beyond this there is a lack of additional supportive effects which would aid the physical therapist in his/her decongestion work. This lack is the reason that from the present perspective of physical therapy, little notice has so far been paid to further improvements in the procedure.

In this chapter a method will be introduced by the author which can significantly improve the effectiveness of IPC beyond its present state. This method represents a new module to MLD and CPE and should be discussed.

6.2 Description of the Method

In order to minimize both damage to nerves and pressure necrosis, as well as to protect against skin damage, a recommendation is to be found in the S1-guideline for IPC from the year 2018 (19). Recommended is a defined padding and the use of a textile skin protection layer between the pneumatic sleeve and the epifacial tissue cylinder during the implementation of IPC. A defined padding, leading to a more evenly distributed pressure, is also to be found in the S2k-guideline (18) on medical compression therapy.

In this chapter, a more detailed description of this defined cushioning insert, together with its protective covering, is to be found. That this combination of components allows for a considerable intensification of the effect of IPC was first publicized in the year 2018 (15). The effect on the edema region to be treated is noticeably increased when a layer of at least 7 cm thickness, made up of elastic foam dice, sized from 0.5 to 1.0, is present between the customary outer pneumatic sleeve and the edema region to be treated.

Fig. 6.1: With the IPK-Plus method a layer of at least 7 cm thickness, made up of elastic foam dice, sized from 0.5 to 1.0, is present between the customary outer pneumatic sleeve and the edema region to be treated.

On the extremities a dice-filled cotton sleeve is used, at other places a cushion is appropriate, the coverings of which can for example be made of a widely available cotton tubular bandage.

A quilting into fixed chambers is intentionally not used, so that the padded inner sleeves can be used in different places in a flexible way, by patting and shifting foam dice by hand according to the needs of the location. This occurs according to the motto “the greater the concentration of dice at any particular spot, the greater the amount of pressure at that point during the treatment”. Thus we have the possibility of an adaptive distribution of the dice within the flexible cotton-covered sleeves, which fit inside the outer, more rigid compression sleeve, which has always been used. Additional inner sleeves - in spite of the overall increased volume - allow thus for an unproblematic seal with the outer compression sleeve. It should be notice that on the question of hygine, the inner sleeves can be machine-washed at high temperature.

In the rest of this chapter, this modified method of treatment will be called “IP-Plus”.

So far, three different kinds of foam of differing firmness have been used since the 1960's under lymphological compression bandages (LCB). If one uses these three firmnesses as part of IPC, the following apply:

- Soft and therefore dentable edemas, post-traumatic swellings with damaged tissue structure - including lipodemas - require the use of 1 cm quadratic cubes of polyurethane foam based on polyether, volume weight =35 and a compression rating of 5,4 kPa in treatment.

- In the case of advanced lymphedema problematic with frequent firm swelling, in order to aid softening of lymphostatic fibrosis, tiny 5 mm cubes made of noticeably harder foam should be used. The best results in praxis tests were achieved with composite foam RG=120 and Trocellen*-C3010 N K93.

At the present time such components still have to be made laboriously by hand. While experimenting with various elastic materials, it became clear to the author that materials with electrostatic properties lead to better decongestion results than antistatic ones.

The author then made a praxis test, using two foams, both having a RG of 35 but differing only in that Type 1 had electrostatic and Type 2 had antistatic properties. The manufacturer prepared the plates in such a way that exact 10 mm cubes were able to be cut out. The same number of cubes were placed in the sleeves. With five patients who had not yet received any therapy, a significantly better decongestion result was achieved by the electrostatic foam as by the use of the antistatic foam.

The tests were done on the patients on two separate days and at the same hour of the day, and with the same degree of swelling. The reasons for the differing type of reaction have not yet been explained.

Using this new padding method, it is possible to treat various body parts morphlogically in a different way. The advantage remains that almost any cavity can be filled, so that IPC is able to be effective there. Such structures can have a natural cause, such as in the retromalleolar or the pelvic regions. But often pathological changes occur in regions which were previously inaccessible to the earlier type of IPC, for example cavities

between lobular skin sacs or post-traumatic breaches resulting from surgical intervention.

All of the IPC measures described in this treatise were carried out with the use of the lympha-mat* Gradient 12 (Boesl Medizintechnik GmbH, Aachen), a pressure controlled 12-Step-System with gradient treatment pressure. The treatment compression sleeves are outfitted with an overlapping air chamber system.

The pause-interval on the control apparatus was set always to 15 seconds, for all treatments. The determination of circumference size was made by hand measurement at 4 cm intervals, thus making volume determinations possible. The entered markings on the measuring points were left for several days.

6.2.1 Tissue Mobilization with IPK-Plus

With the traditional form of IPC, where exclusively a flat, smooth contact with the surface of the skin is made, it is no wonder that hardly any loosening or decongestive effect with respect to fibrotic changes of the skin can be observed.

However, with a IPC-Plus treatment, the undermost layer of the described foam cubes is intermittently pressed into the epifacial tissue cylinder, followed by the moveable upper cubes against the lower layer, setting shear forces into motion. If at the same time the edematic and fibrosic tissue is proximally exposed to reduced compression, the lymph fluids naturally emigrate toward the center, which is the desired effect of the therapy. At the present time, it is still unclear why foam cubes with electrostatic properties are more effective than antistatic foam. From many treatment observations, it is clear that sleeve components, filled with 5 mm foam dice, with good elastic characteristics and high volume weight, allow for the best results in the therapy of indured tissue.

With patients who have advanced chronic lymphedema, coupled with fibrosclerotic changes, treatment wth IPC-Plus has been successfully tried and tested. For this patient group the guideline of the German Society for Lymphology recommends a maximum reduction the lymph edema and a softening of the lymphostatic fibrosis as the initial treatment phase. An actual reduction of the secondary tissue changes has at this point not yet been achieved. Only in Phase II of the CPE is a very slow reduction of the secondary tissue changes to be expected. Thus in the decongestion phase only a basis is created for subsequent improvements in the pathological occurence (1,7). Over a significant length of time, an active and continual participation on the part of the patient is required. Equally necessary is a high quality, exacting implementation of the KPE requirements for the therapeutic steps, and an interdisciplinary collaboration in the supply chain (8).

Fig. 6.2: For softening and decongestion of lymphostatic fibrosis, 5 mm cubes made of much firmer foams are used, the effect can be seen on the skin of the de-edematized limb.

In a mutual study in 2002 (9) of lymph edema patients, a randomized, controlled study with 88 and with 100 test cases, was carried out on patients who had been supervised on a high level under the guidelines for both Phases I and II of MLD/CPE. It was proven in the CPE Phase II that insertion of padding (13) under both lymphological dressing (20) as well as under lymphological compression stockings as inlays (17), that there was a long-term reduction in lymphostatic fibrosis. The evaluating measuring method of this RTC study (10) was then included into the guideline (11) of the Diagnosis and Therapy of the Lymph Edema (1) as well as Dermatoses with Dermal Lymphostasis (4,5).

From these recommendations and study results, IPC-Plus can be used in three different ways for inclusion in practical application. Patients should display a parallel willingness, in connection with the apparative treatment, to carry out their own MLD preparations, as well as to do recommended breathing exercises, in order to set a direction in motion.

- IPC-Plus has shown to be effective with treatment by patients in self-management: after three years of experience by the author (as of December 2019) a large number of patients is able to commit themselves to such a treatment over a long period.
- Practical experience shows that the use of an extensive IPC-Plus treatment immediately before taking measurements for custom lymphological compression stockings, results in an additional reduction in stocking circumference and therefore a good starting point for well-fitting, non-slip stockings.
- The combination of a MLD treatment right before an approximately 60-minute IPC-Plus-treatment makes good sense. The advantage is that the exhausting and tedious therapy work done exclusively by hand is reduced when combined with an IPC-Plus-treatment.

In order to understand the usefulness of the more recent IPC-Plus, consider the following situation: in many cases in Phase II of the CPE a gradual, long-term reduction of the fibrosis can be observed. A requirement however is that in the long run the loosend and decongested status must be preserved. This requires discipline and diligence from the affected patient. An important therapy recommendation for patients is the nightly wearing of self-wrapped compression bandaging, something which is very unpopular with most patients, who are not willing to put up with this over a long time (7,8).

Some patients in our praxis acquire a IPC Home Device, plus defined padding, for treating lymphostatic fibrosis. These patients have without exception previously undergone a guideline-approved CPE (Phase I) and own custom-made flat-weave compression ware. Investigtion by circumference measurement and palpitation in Phase II of CPE demonstrate clearly that a lymphostatic fibrosis was reduced. Our experience shows that good treatment results from Phase I of CPE were not only measureably conserved but optimized. However, to what degree a reduction of fibrosis is possible this way remains hypothetical. We expect corresponding results from relevant investigations. The IPC can be employed both in the decongestion phase and the retention phase of the CPE (3.16).

6.2.2 Edema Reduction

If IPC works in its traditional way, on top of an anatomically firmly formed part of the

body and its particular tissue structure, then such an inevitable subordination to the primary incidents can lead to disadvantageous effects. Examination results from a working group of Olszewski show that even with a high contact pressure of up to 120 mmHg subcutaneously, both in the knee and pelvic regions, a low liquid pressure of only 20 mmHg in the skin tissue could be registered (22). It therefore makes sense, in addition to the already described paddings, to morphologically change anatomical structures. Consequently, attending persons could influence the pressure transfer from the air-filled sleeve to the skin. Based on the data from Olszewski, it seems plausible to increase the pressure transfer with the use of padding in the knee and pelvic regions, in order to improve the decongestive effect.

In a study carried out by the author, two patients who both had extremities that were very swollen,were first treated by traditional IPC for 60 minutes. Even though there were decreases in the circumferences in the distal part of the extremities, in the upper arm and upper thigh there were even small increases. Furthermore, at a series of measuring points 4 cm apart, no changes at all could be determined. As both women had significant arm- and leg lymph edemas but had not so far had any therapy, made it possible to assume that 24 hours later the same conditions would exist. After additional measurements were taken, this assumption was found to be true. During this second visit, an IPC-Plus treatment with the same compression sleeves, pressure strength and length of time was carried out. Under this kind of treatment at all measuring points there was a noticeable decrease in circumferences, distal as well as proximal.

The decongestion results for the patient with the secondary arm lymph edema were: after IPC in the traditional way -43,1 ml as compared to -353,6 ml after IPC-Plus - or 8.2 times greater. With both of these praxis tests, a pants sleeve, size M, and a treatment pressure of 80mmHg were used.
Results for the patient with the secondary leg edema were: -78,4 ml after IPC in the traditional form and -814,0 ml after IPC-Plus with padding. This represents a difference of 10,4 times greater. The pressure for both first and second sittings was 60 mmHg, using a leg sleeve (15).

A further test was made with a 48-year-old female patient with a BMI of 44,8 kg/m2 adipositas-associated lymph edema and lipohypertrophy of both legs as well as mildly dellable swelling. In this case treatment only with the IPC-Plus variation and a leg sleeve was done for six hours, using a pressure of 60 mmHg. After each 120 minutes there was a short pause, during which the patient experienced considerable urination, and a circumference measurement was made every four cm, showing a volume reductions:
Left leg: ***120 min***. = -1443,9 ml / ***240 min***. = -1997,4 ml / ***360 min.*** = -2714,0 ml;
Right leg: ***120 min*** =- 1438,1 ml / ***240 min.*** **=** -1757,9 ml / ***360 min.*** **=** -2528,7 ml

6.2.2.1 Ergebnis

The following can be determined: using the traditional IPC, the amount of edema fluid which is brought into motion from the extremities is limited. Thus for the practitioner of CPE-Therapy, the usefulness of the traditional IPC as a supportive measure is not noticeable. In contrast, not only does the use of IPC-Plus noticeably increase the displacement of fluid, a continual reduction in the size of the edema can be observed over the entire

length of the extremity. If applied over several hours, significant reduction in the volume of the edema can be brought about.

From both these results and extensive practical experience by the author, the pairing of combined MLD-Therapy with IPC-Plus, as carried out by lymph drainage therapist, or, assisted by the patient as self-treatment, can be used in various ways. Prior to individual description, the following should be noted:

The combination of personnel-intensive, professionally applied MLD and an LKV, is heretofore considered the most effective method of reducing an edema. If indispensible - as a part of a Phase I of the CPE - the majority of patients is altogether willing to be treated with a high-quality LKV over a manageable period of time. From the perspective of the author, such a therapeutive step is indispensible and practicable with patients with advanced lymph edemas. Nevertheless, such an intervention is for many patients a considerable burden and must be presented with good arguments presented in a convincing way. When such a measure can be discontinued, because custom lymphological compression stockings (LKSV) are available, many patients are loathe to subject themselves to the highly disliked further step of compression bandaging, though this can from time to time be required.

IPC-Plus aids in supporting therapy because marked decongestion results can be achieved in a short period of time. This characteristic makes it useful in daily therapeutic practice because some possibilities open up which entirely eliminate the need for compression bandaging. The latter occurs when:

- In cases when patients in Phase II of CPE, who for various reasons have increased edemas even though high-quality compression stocking therapy is available to them.
- In cases where edema disease requiring compression therapy can be treated in a session of acceptable duration so the immediately following the praxis session a LKSV measurement can follow. Such a procedure should be repeated an additional time immediately before trying newly-made custom compression ware. This test should be made after a full therapy-free week has passed. It can be expected that due to a IPC-Plus treatment a further edema reduction can be achieved.
- As a compromise and carefully considered decision for patients requiring compression but for whom a Phase I CPE does not seem acceptable.

Furthermore, there is the possibility by additional use of IPC-Plus to reduce the number of therapeutic sessions with MLD as well as to reduce compression bandaging, because the goal of edema reduction can be more quickly achieved.

6.2.3. Lymph Edemas in the Genital and Pelvic Areas

In the previous sub-chapter, where the strong fluid-displacing effect of IPC-Plus is described, it is time to ask the question if IPC-Plus is of possible worrisome concern, since it entails the movement of a log of edema fluid in the ipsilateral direction of the pelvic region.

In patients with edema findings in lower pelvic quadrants or if a genital edema is present, mostly these indicate heavily occulating processes in the lymph drainage system

which are causing the disease. The use of IPC in traditional form is considered contra-indicated for this patient group (1,19).

Special care is always to be used with the use of IPC, if a central drainage disturbance is considered as the possible source for lymph edemas in the legs. Investigations must exclude the possibility that fluid blockages in the pelvic region are the result of congestive problems. It needs to be determined that with the use of IPC no edema reductions and fibroticizing processes in the genital area of in the ipsilateral pelvic quadrants emerge (19, 21).

In the guideline of the German Society of Lymphology, IPC may only be recommended for distally-emphasized arm and leg edemas – without connection to ipsilateral pelvic quadrants (1).

At present there have been no publications that show the possibility of using IPC in traditional form to reduce edemas in pelvic and genital regions (16).

After successful praxis tests by the author, the use of IPC-Plus can solve the inadequate effectiveness of the IPC in traditional form. This inadequacy is known. The anatomical areas in the lower pelvic area can be morphologically changed by using cushioning inserts. According to the principal “the thicker the applied layer, the stronger the resulting pressure below”, the most voluminous layer of foam dice is placed in the area of the crotch, and gradually reduced upwards toward the top of the inflatable sleeve.

So far, with 15 patients in 90-minute IPC-Plus treatments, an effective edema reduction in the genital area was achieved with both men and women. Disadvantages or complaints with the men have not been expressed. It is entirely possible that this favorable compatibility is due to the generous padding (16).

If it is possible with IPC-Plus to successfully treat a central edema configuration, then it suggests that the same body regions can be treated comfortably while at the same time preventing a shift in edema location.

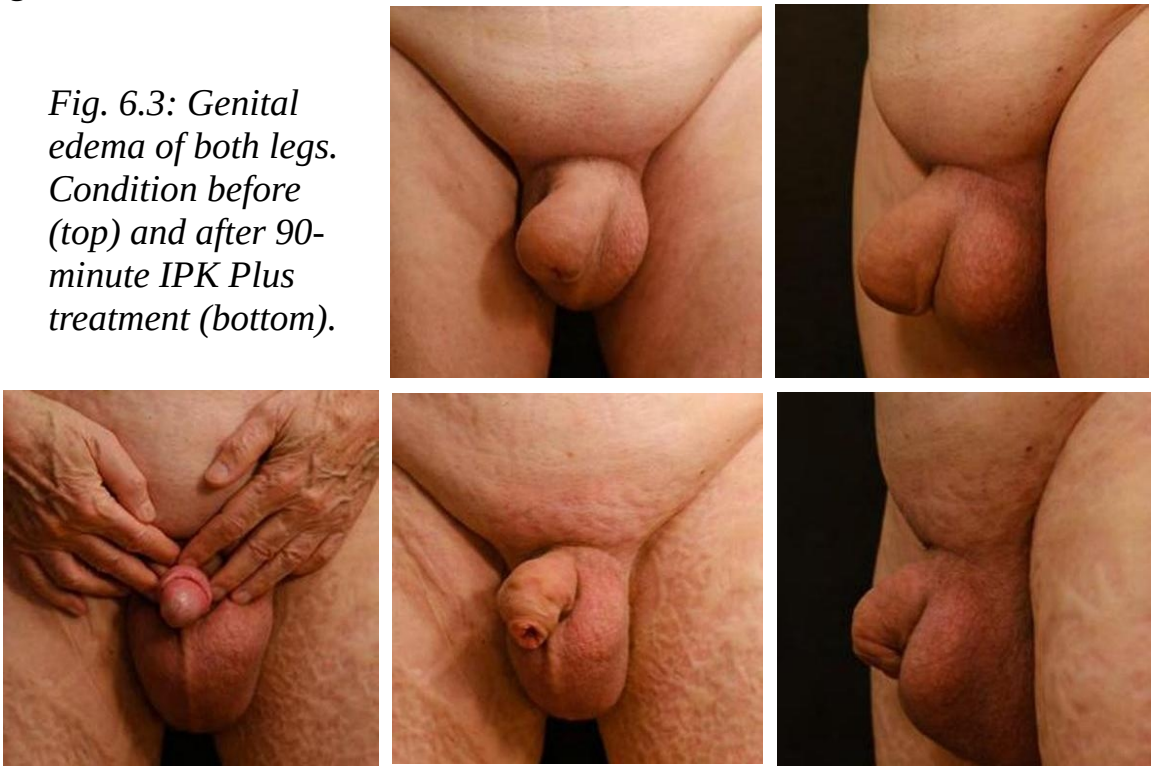

Fig. 6.3: Genital edema of both legs. Condition before (top) and after 90-minute IPK Plus treatment (bottom).

6.2.4. Notes on three Operational Mechanisms of IPC-Plus

For both the selection of the inflatable sleeve and the padding beneath it, and with due regard for the overall clinical picture, attention should be paid to the immediate area at the edge of the sleeve, namely that there are sufficiently functional lymph vessel systems (LGS) in that area.
The question asserts itself speculatively whether or not an edema which has been shoved under an IPC-Plus sleeve reacts sufficiently to an activated safety valve of the locally existing lymph vessel system in order to drain. Until this question can be answered, an IPC-Plus therapy should be combined with MLD treatment. Patients should themselves be able to carry out a prior treatment of breathing exercises and centralized suction stimulation in addition to a self-administrated MLD treatment. The treatment in this paragraph is thus not just a result of IPC-Plus therapy.

6.3. Contraindication

With use of IPC-Plus, the usual known guidelines for the MLD/CPE as well as the IPC guidelines and the listed contraindications apply (19) (see chapter 4.1).
A treatment must be able to be carried out without a complaint from the patient. If this is not possible, an IPC-Plus treatment should not be used. Claustrophobia beyond certain intensities can render treatment impossible. Allergic skin reactions from contact with foam products are very rare.

6.4 Conclusion

IPC-Plus, which is based on classical IPC, works with the additional padding inside the sleeves. The number of cases is still to low for final judgement, but in comparison to the traditional IPC treatments, the following advantages can be noted:

- Per unit of time, the amount of mobilized fluid by IPC-Plus is noticeably greater.
- On the extremities, edema reduction was achieved both distally an proximally.
- The new observation is that a lymphostatic fibrosis can be loosened and even partially eliminated by an apparative method.
- Also new is the possible decongetive effect in the genital and lower pelvic areas.
- A treatment with special padded sleeves is experienced as more pleasant than IPC in the traditional way.

It is being proposed that IPC-Plus become part of the currently valid (until May 2022) Guideline ‘Diagnostics and Therapy of the Lymph Edema’ (1) as additional to defined basis therapy MLD/CPE, particularly in cases of reduced patient mobility as defined in the guideline. At such a guideline-update it should be considered that the application of this method can expanded because of additional observable results.

Note:

For the interested reader, under https://www.methode-morand.de you will find a whole series of application observations. A large spectrum of individual cases is presented. Lymphological diseases of varying genesis and associated complications: everyday, typical challenges for specialized medical-therapeutic personnel for whom lymphology is a main focus. In addition to MLD and CPE, the new module of IPC-Plus is supportively presented. The author, with five years of practical experience, assumes that the successful treatment methods presented can be largely reproduced, because edemas from varying genesis react to this new measure in a very consistent way.

Note from the translator in 2021:
Of the 22 listings in the bibliography, only the numbers 5, 11, 13, 14 and 22 are in English. It is assumed that readers of this article will not pursue the others in German. Should this not be the case, please contact Martin Morand:
morand@t-online.de

Literatur

1. Baumeister R, Döller W, Földi E. et al. S2k Leitlinie Diagnostik und Therapie der Lymphödeme. AWMF Reg.Nr. 058-001, http://www.awmf.org/leitlinien/detail/ll/058-001.html, 2017.
2. Bojinovic-Rodic D. Wirksamkeit der Entstauungstherapie und der apparativen intermittierenden Kompression bei Patientinnen mit Armlymphödem nach Brustkrebsbehandlung. LymphForsch 2019;(23)1:63.
3. Dissemond J, Protz K, Hug J, Kröger K. Patientengerechte Versorgung – Ein Konzept der individualisierten Kompressionstherapie. Vasomed 2017;29:252-253.
4. Dissemond J, Jockenhöfer F, Miller A et al. S1-Leitlinie Dermatosen bei dermaler Lymphostase. AWMF-Register Nr.013/084. http://www.awmf.org/leitlinien/detail/ll/013-084.html, 2017.
5. Dissemond J Jockenhöfer F, Miller A et al. Dermatoses with dermal lymphostasis. J Dtsch Dermatol Ges 2018;16(4):512-523.
6. Jünger M, Morand M, Körner A, Riebe H, Konschake W. Evaluation der Intermittierend Pneumatischen Kompression (IPK) mit berührungsloser Volumenmessung (BT 600). Jahreskongress der Deutschen Gesellschaft für Lymphologie. Bad Krozingen, Oktober 2019.
7. Jungkunz W. Alltagsintegrierte physikalische Entstauung einer bisher therapierefraktären lymphostatischen Elephantiasis. LymphForsch 1998;2(2):108-110.
8. Jungkunz W, Wörmann P, Gatzenberger R. Ambulante Betreuung lymphologischer Patienten LymphForsch 2001;5(2):84–93.
9. Jungkunz HW, Schlaeger M, Schubert E. Therapie der lymphostatischen Fibrosklerose im Hautorgan. Dtsch Dermatol 2013;11:734-8.
10. Jungkunz HW, Massey J, Jungkunz LJ. RCTs zur Behandlung von Lymphödempatienten mit Fibrose. Jahrestagung der Deutschen Gesellschaft für Phlebologie, Bielefeld, September 2018.
11. Jungkunz HW, Massey J. Appropriation of evidence for guidelines. International Lymphoedema Conference, Chicago, June 2019.
12. Leistungsbeschreibung im Rahmenvertrag nach § 125 Abs.2 SGB V, zwischen GKV und Physiotherapeuten; 28.
13. Massey J, Strubel G, Kottmann T et al. Piling on the pressure-proven! Joint International Lymphoedema Framework and International Compression Club Conference, Rotterdam, June 2018.
14. Moffatt CJ, Doherty DC, Morgan P. Best practice for the management of lymphedema. In Lymphedema Framework (ed): International consensus. MEP Ltd, London 2006.
15. Morand M. Methode Morand/IPK-Plus. https://www.methode-morand.de
16. Morand M. Führt eine definierte Abpolsterung unter der Intermittierenden Pneumatischen Kompressionstherapie (IPK-Plus) zu einer Verbesserung der Entstauung beim Lymphödem? LymphForsch 2019;(23)2:108-111.
17. Noori SH, Petereit R, Rindermann J, Jungkunz HW. Reduktion der lymphostatischen Fibrosklerose verschiedener Hautschichten. Eine randomisierte kontrollierte Studie. LymphForsch 2014;18:13-21.
18. Rabe E, Földi E, Gerlach H et al. S2k Leitlinie Medizinische Kompressionstherapie der Extremitäten mit Medizinischem Kompressionsstrumpf (MKS), Phlebologischem Kompressionsverband (PKV) und Medizinischen adaptiven Kompressionssystemen (MAK). AWMF Reg.Nr. 037/005, http://www.awmf.org/leitlinien/detail/ll/037-005.html, 2019.
19. Schwahn-Schreiber C, Breu, FX, Rabe E et al. S1-Leitlinie Intermittierende Pneumatische Kompression (IPK, AIK). AWMF Leitlinien-Registernummer 037-007. www.awmf.org/leitlinien/detail/ll/037-007.html, 2018.
20. Strubel G, Kottmann T, Wörmann P, Jungkunz HW. Kann der lymphologische Kompressionsverband in der Phase II der KPE die Lymphostatische Fibrosklerose reduzieren? Eine randomisierte kontrollierte Studie. ZfW 2015;1:20-27.
21. Weissleder H, Schuchhardt C (Hrsg.). Erkrankungen des Lymphgefäßsystems. Viavital, Köln 2015;592-593.
22. Zaleska M, Olszewski WL et al. Pressures and Timing of Intermittent Pneumatic Compression Devices for Efficient Tissue Fluid and Lymph Flow in Limbs with Lymphedema. Lymphatic Research and Biology 2014;11(4). doi.org/10.1089/lrb.2013.0016.