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The aim of this study was to assess whether adjustable compression wraps are more cost efficient and more effective in achieving the healing of venous leg ulcers than conventional inelastic bandages. Cost calculations and the comparison of the treatment outcome revealed that adjustable compression wraps are significantly cheaper and more effective (not statistically significant) in the treatment of venous leg ulcers, than inelastic bandages.

### **Importance of adequate pressure in compression therapy. Basis for successful treatment**

In this study, the actual pressure course under different compression materials in different clinical situations was investigated and compared. As a consequence of the findings of the present study, it is postulated that, at least in studies comparing different compression media, pressure measurements should be carried out in the future, whereby the measuring point and body position should be documented.

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The authors reviewed the usage of round-knit and flat-knit compression garments for the maintenance phase in lymphedema treatment based on current literature. They concluded that the choice of compression stockings for the treatment of lymphedema should be based on clinical findings / presentation of the leg and not exclusively on diagnosis. Typical indications for flat-knit compression like significant differences in circumference, deep skin folds and pronounced edema of the toes and/or forefoot exist, however, lymphedema patients who can be adequately treated with round-knit compression stockings with a high degree of stiffness exist.

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## Adjustable compression wrap devices are cheaper and more effective than inelastic bandages for venous leg ulcer healing. A Multicentric Italian Randomized Clinical Experience

*Phlebology 2019:1-10*

### Aim

The aim of this study was to assess whether adjustable compression wraps are more cost efficient and more effective in achieving the healing of venous leg ulcers than conventional inelastic bandages

### Methods

A total of 66 patients with venous leg ulcers (ABI > 0.8, wound size ranging from 5 to 100 cm<sup>2</sup>, ulcer duration of > 3 month) were admitted to this randomized, multicentric, prospective trial. Patients were either treated with an adjustable compression wrap (CircAid® JuxtaCure®) (n = 33) or inelastic bandage (Coban 2 Layer®) (n = 33) for a duration of 12 weeks. During weekly visits, the ulcers were cleansed and dressed with the same products. Ulcer size was assessed

by digital planimetry, while ulcer pain and patient's perception of compression systems were assessed by Visual Analogue Scale (VAS). The material cost was evaluated at the end of the study.

### Results

According to this study adjustable compression wraps were significantly cheaper than bandages (p < 0.0001). To heal one ulcer patient, 228 € had to be spent when applying an adjustable compression wrap and 381 € if inelastic bandages were used. Interestingly, adjustable compression wraps were also more effective in achieving ulcer healing, however not significantly. About 26/33 (78.82%) patients in the adjustable compression wrap group were healed after 12 weeks versus 23/33 (69.7%) in the inelastic bandage group.

Ulcer pain was reduced for both compression systems. Patient perception of compression pressure was similar with both compression devices and measured compression pressure was similar at application of the device but better maintained over time by the adjustable compression wrap.

### Conclusions

Cost calculations performed within this study revealed that treatment with adjustable compression wraps is significantly cheaper and more effective (not statistically significant) in achieving venous leg ulcer healing than inelastic bandages. Self-applicable, adjustable compression wraps are therefore a powerful, cost-effective alternative to inelastic bandages in treating venous leg ulcer.

**Comments of the Editors**

In this study the authors could demonstrate lower material costs for compression in venous leg ulcer patients with adjustable compression wraps compared to inelastic bandaging using a standard two-layer bandage system. The main reason is that the bandage system has to be renewed after each visit whereas the wraps can be reused. Both systems have a high static stiffness index at removal although the sub-bandage pressure below the bandage system drops significantly more compared to the wrap. Pain reduction was comparable and ulcer healing was insignificantly better with wraps. However, the study was not powered for the endpoint “ulcer healing”.

One of the benefits of adjustable compression wraps is the self-management by the patient which is less applicable with compression bandage systems. In consequence the cost-saving effect is even higher compared to the pure material costs as the reduction of personal costs for bandage changing may be added.

Compression bandages are still the gold standard for ulcer treatment in most of the international guidelines although two-layer ulcer stockings have proven to be as effective and cost-saving if applicable. With a new generation of compression devices, “adjustable compression wraps”, effectivity and cost-saving can be achieved also in patients where ulcer stockings may not be applicable.

Partsch H, Stücker M, Vanscheidt W, Läubli S, Eder S, Protz K, Dissemond J

## Importance of adequate pressure in compression therapy. Basis for successful treatment

*Der Hautarzt; Springer Medizin Verlag GmbH 2019:1-8*

### Aim

Pressure data of different compression materials are hardly to be found in the literature, and still many comparisons on the efficacy of compression materials are published without information on compression dosage. In this study, the actual pressure course under different compression materials in different clinical situations was investigated and compared.

### Methods

Pressure measurements were carried out under different compression materials in lying, standing and walking positions using a PicoPress® device (Fa. Microlab, Roncaglia di Ponte San Nicolò, Italy) at measuring point B1, approx. 12 cm proximal of the inner ankle. The PicoPress® device enables continuous pressure registration, can be left under a bandage for several days, and results can be easily displayed and evaluated with the aid of the supplied software.

Pressure measurements under different compression materials were performed in self-experimentation, on patients with venous leg ulcer and in one patient with massive varicosis of the V. saphena magna. The 24 patients with venous leg ulcer included 16 women and 8 men aged 39 to 86 years (average 64.7 years), all with a premeasured Ankle-Brachial Index (ABI) above 0.8.

The following compression materials were used for the pressure measurements:

- elastic compression material in the form of compression stockings of the companies Sigvaris (Memmingen, Germany) and medi (Bayreuth, Germany);
- inelastic two-component compression system with pressure indicators of the company Urgo (Sulzbach, Germany);
- inelastic multi-component bandages of the companies 3M (Neuss, Germany), Lohmann & Rauscher (Neuwied, Germany) and Smith & Nephew (Hamburg, Germany).

### Results

The results of this study showed that the pressure varied considerably depending on the compression material used, the firmness of application, the local configuration (body position) and the time interval between application and measurement. Compared to elastic material, the pressure increase during standing and walking is higher with inelastic material and leads to higher pressure peaks during muscle contraction. A loss of pressure occurred under each form of applied compression therapy, especially under inelastic short-stretch material, which was mainly due to movement and edema reduction. This pressure loss is decisive for the timing of dressing changes and a reason for the good tolerance of high-pressure levels in mobile patients.

### Conclusions

This study shows that the compression pressure is not a stable value and that the required pressure depends on the treatment objective. While low pressures are mainly suitable for edema reduction, higher pressures (60 – 80 mmHg) are required for hemodynamic effects. For this purpose, inelastic materials are preferred which enable lower pressures when lying down (40 – 60 mmHg). Pressure measurements with appropriate instruments are recommended for training purposes and scientific studies, but not for routine use. However, as compression bandages are often too loosely applied by many users, pressure indicators on bandages or adaptive bandages with pressure templates are helpful to apply the material with the correct pressure. As a consequence of these findings it is postulated that, at least in studies comparing different compression media, pressure measurements should be carried out in the future, whereby the measuring point and body position should be documented.

### Comments of the Editors

The authors of this study have demonstrated that different compression materials and application techniques lead to different pressure levels beneath compression. This is important as improvement of pathologic venous hemodynamic parameters need high pressures of above 40 mmHg. A high resting pressure has its limitations as it may not be very comfortable to have a permanent pressure over 50 mmHg below a bandage. However, hemodynamic pathology is not so important in supine compared to upright position. Therefore, high pressure peaks during walking are key to improve hemodynamics. This can be achieved not only by high resting pressure but also by high static stiffness index using inelastic material as adjustable compression wraps.

Hemodynamic improvement plays an important role in severe chronic venous insufficiency like in venous ulcer patients. Improvement of ulcer healing has been demonstrated by high pressure compression but

also by two-layer ulcer compression stockings with a resting pressure below 40 mmHg and with a comparably high static stiffness index. For less severe venous insufficiency like varicose veins with moderate evening oedema also low pressure and more elastic compression seems applicable.

Reich-Schupke S, Stücker M

## Round-knit or flat-knit compression garments for maintenance therapy of lymphedema of the leg? Review of the literature and technical data

Deutsche Dermatologische Gesellschaft, published by John Wiley & Sons Ltd 2019

### Aim

This article aimed to review the usage of round-knit and flat-knit compression garments for the maintenance phase in lymphedema treatment based on current literature, clinical experience and available technical data.

### Methods

Input from published data on lymphedema treatment, flat- or round knitted compressions garments and clinical experience of the authors have contributed to this review.

### Results

The extent to which the various treatment components are used depends on the treatment phase. In phase 1 of the complex decongestive therapy (CDT), which is intended to promote decongestion the main treatment components are lymphatic drainage and compression bandages. In phase 2 of the CDT, the so-called maintenance therapy, the focus lies on manual lymphatic drainage as needed and compression stocking. While adaptive compression systems are also used in both phases of CDT in other countries, these systems have not yet been approved in Germany for this indication.

### *What do the guidelines and the literature say?*

The current lymphedema guidelines require the use of compression bandages in phase 1 of the CDT and flat-knit compression stockings in phase 2 of the CDT. While there is enough data as to the therapeutic value of compression therapy in the treatment of lymphedema, there have been no studies comparing the safety and efficacy of round-knit and flat-knit compression garments, neither do the recommendations relating to compression therapy contained in the guidelines distinguish between the different stages of lymphedema.

### *What are the characteristics that differentiate round-knit and flat-knit fabrics?*

While flat-knit fabrics can be used to apply compression to virtually every region of the body and for almost every possible circumference, treatment with round-knit fabrics is subject to limitations as they cannot be used in patients with extreme differences in leg circumference or a highly unusual leg shape. The different knitting techniques of round-knit and flat-knit fabrics have also an influence on how stiff and flexible a fabric is produced. One potential complication in the

treatment of lymphedema using compression stockings involves the formation of constriction marks in skin folds, such as those frequently seen between the toes and the back of the foot or between the back of the foot and the lower leg. A generally stiffer and more inflexible flat-knit fabric show less of a tendency to form constriction marks in skin folds, than a less stiff and more flexible round-knitted fabric would.

Long stretch versus short stretch A knit fabric has short-stretch characteristics if it has relatively little elasticity and stretchability. This gives rise to a high working pressure. By contrast, long-stretch fabrics are highly stretchable and very elastic. They generate lower working pressure but a high resting pressure. The long or short stretch characteristics of a fabric are mainly affected by the type of spandex that is used. Long-stretch spandex is typically used for round-knit compression stockings, flat-knit compression stockings tend to contain short-stretch spandex. However, this is not true for all cases, and round-knit compression stockings containing short-stretch spandex can result in an unusually high degree of stiffness.



*Why is it so important in routine clinical practice to carefully consider the choice of fabric?*

According to the authors of the paper, two main aspects play a key role in addition to the clinical indication: 1) economic aspects and 2) patient adherence. Costs for flat-knit fabric might be twice as high as for comparable round-knit fabrics and known disadvantages of flat-knit fabrics (rigidity of the materials during sporting activities, uniform feeling on the skin, lack of fashion varieties) might negatively influence adherence related to the long-term use. Under these aspects it should be subject to critical review whether every lymphedema patient actually requires treatment with flat-knit stockings.

*Choosing compression stockings based on clinical findings*

Many patients with clinically manifest, advanced lymphedema require treatment with flat-knit fabrics. In general, there are four relevant questions that need to be answered before deciding on the most adequate type of compression therapy in patients with edema. If the extremity is decongested and the extremities show extreme differences in circumference, stage 3 disease or stage 2 with foot involvement or deep skin folds, then a flat-knit fabric should be considered in the majority of cases.

### Conclusions

According to the authors practical conclusions, the choice of compression garments for the treatment of lymphedema should be based on clinical findings and not exclusively on the initial diagnosis. Significant differences in circumference, deep skin folds and pronounced edema of the toes and/or forefoot are typical indications for flat-knit com-

pression stockings, however, there are lymphedema patients who can adequately be treated with round-knit compression garments. Further important factors like economic aspects, patient adherence and the presentation of the affected limb have to be considered in the choice of the most appropriate compression garment type for a particular patient.

### Comments of the Editors

The tradition to use inelastic material in the treatment of lymphedema may be also endorsed by some theoretical considerations based on early experimental findings which are not well known. In 1938 McMaster and Parsons showed in a rabbit ear model that arterial pulsations were required for local lymphatic removal of subcutaneously injected tracer molecules, while steady perfusion of the artery at the same mean arterial pressure stopped lymph flow.

Oscillating forces transiently change the interstitial-intraluminal fluid pressure gradient, producing periodic movement into initial lymphatics. Due to the resulting increase of the lymphatic resorption via the initial lymphatics there is an increase of the lymphatic load to be transported in the lymph-collectors leading to an increase of the spontaneous contractility in the collectors. Also tissue deformations induced by oscillating forces as they occur due to activities such as walking, passive limb movements, or gentle skin massage promotes lymph clearance. The importance of these oscillating forces explains why wearing stiff compression material can result in a massaging effect of the tissue due to muscular activity. Also, the enhanced arterial pulsation under a stiff compression device explains, why a stiffer material is the preferred compression material in lymphedema patients.

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