CONSENSUS STATEMENT

Indications for compression therapy in venous and lymphatic disease
Consensus based on experimental data and scientific evidence

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Aim. **The aim of this study was to review published literature concerning the use of compression treatments in the management of venous and lymphatic diseases and establish where reliable evidence exists to justify the use of medical compression and where further research is required to address areas of uncertainty.**
Methods. **The authors searched medical literature databases and reviewed their own collections of papers, monographs and books for papers providing information about the effects of compression and randomized clinical trials of compression devices. Papers were classified in accordance with the recommendations of the GRADE group to categorize their scientific reliability. Further classification was made according to the particular clinical problem that was addressed in the papers. The review included papers on compression stockings, bandages and intermittent pneumatic compression devices.**
Results. **The International Compression Club met once in Vienna and corresponded by email in order to reach an agreement of how the data should be interpreted. A wide range of compression levels was reported to be effective. Low levels of compression 10-30 mmHg applied by stockings are effective in the management of telangiectases after sclerotherapy, varicose veins in pregnancy, the prevention of edema and deep vein thrombosis (DVT). High levels of compression produced by bandaging and strong compression stockings (30-40 mmHg) are effective at healing leg ulcers and preventing progression of post-thrombotic syndrome as well as in the management of lymphedema. In some areas no reliable evidence was available to permit recommendations of level of compression or duration of treatment. These included: management of varicose veins to prevent progression, following surgical treatment or sclerotherapy for varicose veins, and the level of compression required to treat acute DVT.**
Conclusion. **This review shows that whilst good evidence for the use of compression is available in some clinical indications, there is much still to be discovered. Little is know about dosimetry in compression, for how long and at what level compression should be applied. The differing effects of elastic and short-stretch compression are also little understood.**
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Key words: **Vascular diseases - Lymphedema - Venous thrombosis - Stockings, compression - Bandages - Intermittent pneumatic compression devices - Review.**

Compression therapy is recognized as an effective treatment in the management of venous and lymphatic disease since thousands of years . Until recently evidence of efficacy was based on empirical study and little objective research had been performed. More detailed information has now been obtained from published clinical series and randomized controlled trials. These have been summarized in books and monographs.[1-8] National and international guidelines on compression treatment have been published by a number of different societies.[9-15] Many of the published recommendations which suggest particular levels

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*Members of the International Compression Club (ICC).

TABLE I.—*Summary of publications (reference numbers) reporting experimental data with compression therapy. (For details see Table IA in the Appendix).*

Experimental effects	Compression stockings			Bandages	IPC
	Compression pressure in mmHg				
	10-20 mmHg	20-30 mmHg	30-40 mmHg		
Edema prevention	19-21	20, 22-24	25		
Edema reduction	26, 27	22, 25, 26, 28		29	30-34
Increase venous flow velocity	35	36, 37			38-48
Reduction of venous diameter	49	37		50, 51	
Reduction of venous reflux			52-54	53-55	
Improvement of venous pump		56-62	58	53, 63	
Reduction of ambulatory venous hypertension			64	63	
Increase of arterial flow	65			66	67-76
Improvement of microcirculation		28, 77-83		79	77, 84-90
Improvement of lymph-drainage				91-94	95-97

IPC: intermittent pneumatic compression.

of compression to be used in specific indications are based on the experience of the authors rather than on evidence from clinical trials.[16, 17]

The main aim of this document is to give an overview of existing knowledge, identifying areas of knowledge where good scientific evidence is available from clinical trials and areas for which little or no evidence is available and which should become the subject of future research.

Materials and methods

The International Compression Club (ICC) is an *ad hoc* group of experts which includes clinicians involved in the management of patients with venous disease as well as technical specialists from companies manufacturing compression devices for clinical use. This group was to review and to comment critically on published literature on compression therapy concentrating on two issues:

1. experimental findings concerning clinically relevant effects of compression therapy;
2. randomized clinical trials (RCTs) addressing the use of compression for particular clinical indications.

The ICC searched medical literature databases as well as their own collections of papers in order to find relevant medical literature.

The findings were presented by several members of the group and discussed at a meeting of the ICC, held in May 2007 in Vienna, Austria. The assessment of the strength of the recommendations from randomized trials was based on the scoring criteria from the international GRADE group.[18] Thereafter, the data were summarized in tables that were circulated among the members of the ICC by e-mail. The corrected version of these tables was agreed by a majority of the active participants at a follow-up ICC meeting, held in November 2007 in Paris.

Results

The outcome of this initiative is summarized in Tables I and II; details are given in the Appendix (Tables IA and IIA) .The tables are structured in alignment with the clinical stages of the CEAP classification [171] supplemented by the indications of deep vein thrombosis (DVT), post-thrombotic syndrome and lymphedema.

A number of different methods of classifying compression garments is used and varies from country to country. The tables are constructed using the interface pressure of medical compression stockings (MCS) given in millimeters of mercury (mmHg) ranges to avoid any confusion. By international agreement, compression applied to the limb by a stocking is calculated from an analy-

TABLE II.—*Efficacy of compression therapy stockings, bandages and intermittent pneumatic compression by randomized controlled trials and meta-analyses in patients with chronic venous disorders (CEAP), venous thromboembolism and lymphedema. Only strong grades of recommendation: (1A and 1B) are indicated.*[18] *(Reference numbers in brackets.) A complete list is given in Table IIA in the Appendix..*

Indications CEAP	Compression stockings			Bandages	IPC
	Compression pressure in mmHg				
	10-20 mmHg	20-30 mmHg	30-40 mmHg		
EC0s, C1s	1B (98, 99)				
C1 after sclero		1B (100)			
C2 a,s	?	?	?	?	?
C2s pregnancy	1B (101)	1B (101)			
C3 prevention	1B (21)				
C3 therapy	?	?	?	?	?
C4b			1B (102)		
C5			1A (103)		
C6			1B (104-106)	1A (107)	
After procedures			1B (108)	1B (109)	
VTE					
Prevention	1A (110-112)[168]				1A (111, 112)
Therapy		1B (113, 114)		1B (113, 115, 116)	
PTS					
Prevention			1A (117, 118)		
Therapy					1B (119)
Lymphedema	?	?	?	?	
Therapy				1B (120, 121)	1B (122)

sis of the mechanical properties of the stockings by manufacturers and not by direct interface pressure measurement. The pressure ranges correspond to the values that are assumed to be exerted on the ankle region based on *in vitro* measurements by the manufacturers for a certain range of leg circumferences.[172, 173] These pressure ranges may not always be exactly the same as those given in the individual publications due to different national classification systems.

Intermittent pneumatic compression (IPC) is included since it offers an interesting model to study physiological effects of compression therapy.

Experimental data

Table I presents the summary of experimental data describing effects of compression therapy on different physiological parameters. Table IA in the Appendix gives more detailed information. The main focus of the outcome was put on vascular problems of the extremities, to some extent supplemented by outcomes and findings from research into trauma. However, effects of compression on burns, scar formation or on the general circulation were not reviewed.

Several experimental studies demonstrated that compression stockings from all three pressure ranges considered here are able to prevent and to reduce leg edema.[19-29] External pressure increases the tissue pressure.[123] Interestingly a low pressure around 10 mmHg is enough to impede leg swelling in a prolonged upright position.[19-21] Dramatic decrease of edema was also demonstrated after IPC.[30-34]

Reduction of venous diameter and increase of venous flow velocity depend on the relative values of intravenous pressure and compression pressure. In the supine position, light antithrombotic stockings are able to decrease venous diameter and to increase venous flow velocity.[35-37, 49] Some studies were unable to detect an increase of venous flow velocity by duplex ultrasonography.[124-126] There are a number of factors which limits the accuracy of duplex ultrasound in this application, but it should be noted that peak flow velocity measured in this way is a rather poor parameter to characterize the mean flow velocity under a compression stocking. IPC produced clearly detectable flow acceleration in several experimental studies.[38-48] In the upright position, much higher external pressures are necessary in order to reduce the diameter of leg veins.[49-51, 127] This explains the fact that reduction of venous reflux measured in the upright position could only be demonstrated under high compression pressure exerted by strong stockings, bandages or a Velcro-band device.[52-55]

Several plethysmographic studies performed in patients with chronic venous insufficiency showed an improvement of the venous pump was produced by the application of MCS, bandages [56-62] and by a Velcro band device.[53]

Conflicting results have been reported when venous function was assessed by measurement of ambulatory venous hypertension in patients with chronic venous insufficiency. Two studies assessed the effect of application of strong stockings [64] and by strong short stretch bandages [63] and found a reduction of the peak pressure values during walking. Other reports, which measured the reduction in venous pressure during walking were unable to find a significant improvement of ambulatory venous hypertension.[59, 124] This example shows that an agreement concerning the interpretation of venous pressure measurements is still lacking.

The influence of external compression on the arterial flow is a critical issue. In a number of studies performed especially on supine or reclining volunteers, it was found that a sustained external pressure >60 mmHg will diminish local blood flow.[128-131] Bandages and elastic wraps exerting a pressure of around 30 mmHg do not reduce sub-bandage flow, but diminish toe perfusion.[132] In normal extremities, inelastic bandages with a pressure of 38 mmHg increase blood perfusion,[66] 13-23 mmHg arm-sleeves increase blood flow.[65]

An impressive series of experiments shows unequivocally that IPC increases arterial inflow.[67-76] Special devices producing short phases of pressure waves up to 180 mmHg have been shown to increase arterial flow, even in patients with arterial occlusive disease and in severe stages of ischemia.[69-71, 73-76]

Effects of compression on different microcirculatory parameters have been reported. Laser Doppler flux in the skin increases up to a pressure of 20 mmHg in the supine position, and up to 60 mmHg in the sitting position.[77] MCS are able to reduce capillary filtration and pericapillary edema,[78-82] to tighten paracellular junctions [83] and to increase capillary density,[79, 80] thereby improving tissue oxygenation.[81, 82, 84] One study was unable to demonstrate a profibrinolytic effect of elastic bandages.[133]

Data from investigation of the microcirculation and release of biomarkers come from studies where IPC was applied to the extremities.[84-90, 134-140] Several studies describe an increase of capillary perfusion and of tissue oxygenation,[77, 84-87] which is in accordance with the observation of an increased release of nitric oxide,[88, 89] with an up regulation of the fibrinolytic potential of endothelial cells [88, 136, 137] and with a suppression of procoagulant activation.[140] Some reports did not find an increase of fibrinolytic activity after IPC.[138, 139] The increase of bone mineral density after IPC [134, 135] shows that IPC is able to influence other tissues of the limbs, and is not limited to effects on the skin microcirculation.

Experimental data concerning the effect of conventional compression therapy on lymphedema are sparse.[91-96] IPC is able to reduce the water content of a lymphedematous extremity without improving the lymphatic drainage to an adequate amount.[95, 96] This leads to an increase of the oncotic tissue pressure [96] necessitating a continuation of compression therapy by bandages and stockings.

Randomized clinical trials

In those areas in which reviews and meta-analyses already exist, only papers published after these reviews were included in Table II.

For the assessment of the RCTs, the recently proposed GRADE system to score the recommendation-level of each study was used.[18] Recommendations defined as strong (grade 1) or weak (grade 2) refer to the text in the outcome-column (Table II and Table IIA in the Appendix). The quality of evidence is classified as high (grade A) or moderate (grade B) according to the study design and the consistency of the results. Observational studies or case series corresponding to the recommendation grade C were not taken into account. The ratings were based on the votes of the majority of the active participants at the ICC meetings.

Several RCTs have proved the clinical efficacy of light compression stockings with a pressure <20 mmHg in the following indications:

— improvement of symptoms of venous disease, such as heaviness in patients with CEAP C0s-C1s [98, 99] and in varicose veins of pregnancy [101] (Grade 1B);

— prevention of leg swelling related to prolonged sitting and standing ("occupational leg edema") (recommendation level Grade 1B);[21]

— prevention of venous thromboembolism in bed-ridden patients, especially after general surgery (Grade 1A).[110-112, 168]

Some trials revealed that low pressure stockings have no, or only doubtful, benefits following varicose vein surgery (Grade 2B).[147-149, 151]

MCS with a pressure range of 20-30 mmHg produce beneficial clinical effects (Grade 1B recommendations):

— after sclerotherapy of small teleangiectasias;[100]

— concerning an improvement of subjective symptoms in varicose veins of pregnancy;[101]

— for the treatment of acute DVT.[113, 114]

The recommendations for using compression stockings with a pressure range of 20-30 mmHg in patients with asymptomatic or symptomatic varicose veins,[143, 144] for the prevention of varicose veins after surgery [146] or of venous edema [24] and for treating venous ulcers [163] are weak (all Grades 2B).

For MCS with a pressure range between 30 and 40 mmHg randomized controlled trials could be found allowing strong recommendations:

— better outcome after sclerotherapy compared to light bandages;[108]

— such stockings are able to reduce lipodermatosclerotic areas on the leg (CEAP C4b) [102] and to heal venous ulcers [104-106] (all Grade 1B);

— MCS reduce the recurrence rate of venous ulcers after healing, higher pressure ranges seem to be superior [103, 152] (Grade 1A);

— two studies were able to demonstrate that the rate of post-thrombotic syndrome after proximal DVT can be reduced by wearing compression stockings with 30-40 mmHg for the following years [117, 118] (Grade 1A). One three-part study performed in a restricted number of patients failed to show a beneficial effect of stockings 1 year after DVT [169] (Grade 2B).

Up to now no convincing data are available supporting the use of compression stockings in patients with post-thrombotic syndrome [119] (Grade 2B).

For the use of compression bandages strong recommendations can be given:

— in patients with venous ulcers (CEAP C6) [107] (Grade 1A);

— for the management of acute DVT [113, 115, 116] and lymphoedemaedema [120, 121] (both Grade 1B);

— high pressure bandages reduce bleeding after venous surgery,[109] but lose pressure more than MCS.[150] For patient comfort stockings may be better tolerated than bandages [108, 145] (all Grade 1 B).

The classical model to assess the efficacy of compression therapy is the venous leg ulcer. In this indication an extensive Cochrane review showed that:

— compression is better than no compression and higher pressure exerted by multilayer bandages provides better results than low pressure [107, 164] (Grade 1A-C);

— four-layer bandages were shown to be more effective than three-[155] or two-layer-bandages,[156] than the "usual system of care" [157, 164] and than single layers of short stretch bandages [158, 161] (Grade 1B);

— a Velcro-band device achieved faster ulcer-healing than four layer bandages [162] (Grade 1B);

— several trials did not show significant differences of ulcer healing rates between four layer and short stretch systems [153, 154, 159, 160, 164] (Grade 1B).

For IPC the present level of evidence in ulcer healing is weak.[165-167] Strong levels of evidence support the use of IPC:

— in the area of thrombosis prevention after surgery [111, 112] (Grade 1A);

— in the treatment of post-thrombotic syndrome;[119]
— in lymphedema [122] (both Grade 1B).

Discussion and conclusions

Our analysis focuses on the following three main points which have considerable practical importance:
1. What is the effective range of compression pressure?
2. Are there differences concerning the mode of action depending on different compression material?
3. Which are the main points to be investigated in future research?

These points are discussed on the basis of the presented data, both concerning experimental and randomized clinical studies.

Compression pressure

The levels of compression which have been shown to be effective in different experiments are in the range between 5-10 mmHg and >120 mmHg. It is crucial to differentiate between sustained and intermittent pressure. Data from studies of the skin microcirculation show that ischemic skin damage may result from high levels of compression applied for a long period of time. Depending on the body position and the particular anatomical location of the compressed skin, a sustained pressure of 60-70 mmHg may be considered as a maximum upper limit, especially over bony prominences in patients with normal arterial circulation.[128-130]

In contrast, experiments with intermittent pneumatic pumps have demonstrated an increase of arterial blood flow using short-duration pressure peaks >120 mmHg followed by intervals of low pressure. These findings have been obtained in volunteers with normal arterial circulation as well as in patients with arterial occlusive disease.[67-76] It was found that the relative increase of arterial flow was more pronounced in the upright (sitting) position than in the supine position.[67]

Light stockings (10-15 mmHg) have been reported to provide beneficial effects through reduction of edema formation after prolonged sitting and standing, and an increase of venous blood flow velocity in the supine position.[19-21, 35] They can also be used as a "liner" to keep local ulcer dressings in place. A second stocking applied over this liner has been introduced by some companies as a special kit for treating venous ulcers.

In the upright position, higher pressures were more effective with regard to narrowing of leg veins, the decrease of venous reflux and the enhancement of venous pump function in patients with chronic venous insufficiency.[51, 53-55] Some experiments were able to demonstrate a dose-response relationship between the interface pressure and an experimental effect. High pressure, but not low pressure, is able to reduce ambulatory venous hypertension.[63]

Intermittent compression not only improves arterial inflow and microcirculation, but also has profound effects on the release of anti-inflammatory, vasoactive and anticoagulatory mediators and substances.[88-90, 136, 137, 140]

Compression material

The elastic properties of the compression device play a crucial role in the relationship between sustained (resting) pressure and the pressure during standing and walking (working pressure).

A sustained pressure that is maintained day and night is achieved by material containing elastic fibers (MCS, long-stretch, elastic bandages) while stiff and short stretch material exerts a lower resting pressure and high pressure peaks during walking, comparable to the action of intermittent pressure pumps which produce peaks by inflation of inelastic cuffs. MCS that exert a pressure of 40 mmHg and more are not only difficult to apply, but in most cases also not well tolerated during rest. If a pressure of >40 mmHg is required, it may be preferable to achieve this with material with high stiffness, such as inelastic, short-stretch bandages, multilayer bandages or adhesive or cohesive bandages.

Some experiments have shown that in spite of exerting the same resting pressure, inelastic bandage systems or Velcro-band devices achieve more-pronounced hemodynamic effects than elastic material.[53, 54] This can be explained by the higher pressure peaks (working pressure) under the inelastic material. With inelastic bandages, pressure peaks of 80 mmHg and more can be measured during walking. When the patients lie down the pressure will decline to a resting pressure of about 40 mmHg which is tolerable.[174] The most impressive demonstration of hemodynamic effects comes from experiments with intermittent pneumatic pumps, which can be considered as models for walking with completely inelastic devices.

Comparisons between different compression materials have been done principally in studies involving patients with venous leg ulcers. It must be kept in mind that the application technique and the pressure exerted vary enormously depending on the skill and the experience of the bandager. This is an important consideration when evaluating studies comparing different kinds of compression bandages. Another important point to be considered is possible misleading reporting in some trials, for instance when the use of a local ulcer dressing together with one padding layer and one bandage layer is declared as a "three-layer bandage". The best healing rates of venous ulcers reported to date were obtained by multilayer bandages expected to exert pressures of ≥40 mmHg (Grade 1A).[107] In recent years, several RCTs have been published demonstrating better healing rates with specially designed double-layer compression stockings in comparison to different compression bandages (Grade 1B).[104-106, 163]

Randomized controlled trials proving the clinical efficacy of IPC exist especially for the indication of mechanical prevention of venous thromboembolism (Grade 1A) [110-112] and for lymphedema (Grade 1B).[122] Specially designed IPC systems have shown promising results in patients with arterial occlusive disease.[69-71, 73-76]

Areas of poor knowledge (future studies needed)

Experimental data deficits

Some areas in which future experiments should clarify open questions or endorse sparse existing observations are summarized below:

— relationship between pressure/material/time (=dose) and volume reduction (=response) in the treatment of edema, initial phase and maintenance phase of therapy, level and duration of sustained and intermittent pressure;

— mechanism of action of different kinds of pressure applications, effects on the physical and biochemical properties of different tissue compartments and on lymph-drainage;

— dose-response relationship for different pressures and materials on venous reflux, venous pump and ambulatory venous hypertension;

— influence of MCS and bandages on the arterial circulation;

— influence of MCS and bandages on the microcirculation, on endothelial cells, cytokines, and mediators (some data are available after IPC);

— rationale for pressure gradient in different body positions;

— local increase of pressure by positive eccentric compression: what is the experimental proof for the efficacy of local pressure pads?

— loss of interface pressure over time with different compression materials, correlated with change of efficacy.

Need for randomized clinical trials

In general, the pressure of the compression devices tested for different indications is only vaguely described in the existing RCTs. In the case of MCS a compression class or a pressure range indicated by the manufacturers is usually given, but the pressure exerted on the individual leg remains unclear. This is even more of a problem with compression bandages. There are hints coming from experimental and from clinical trials that the clinical effect of a compression product will change with the exerted pressure, which therefore should be measured in future trials.[174]

Indications in which the efficacy of compression therapy is not yet well documented by RCTs correspond to the white areas in Table II and are listed below:

— symptomatic and asymptomatic varicose veins (CEAP C1, C2, a,s): is compression therapy able to prevent progression and complications?

— what is the role of compression in the management of venous edema (C3)?

— sclerotherapy and interventional procedures of varicose veins: the quality of the compression products in the reported trials is often questionable and the outcome parameters are weak. Up to now, no single trial compared compression *versus* no compression following removal of varicose veins (C2) or refluxing veins (C3-C6) by surgery or endovenous procedures;

— optimal compression therapy for the ambulant management of acute DVT, adjusted to the level and extent of DVT and to the mobility of the patient;

— superficial phlebitis: no single RCT demonstrates the effect of compression;

— role of compression therapy in the management of post-thrombotic syndrome;

— lymphedema: most existing RCTs compare compression as one element of complex physical decongestion therapy with the same basic treatment in addition to another modality;

— correlation between pressure (measured *in vitro* and *in vivo*) and clinical effects (reduction of edema, improvement of lipodermatosclerosis, healing rate of venous ulcers, recurrence rate after ulcer healing, improvement of pain and swelling in acute DVT);

— efficacy of newly-developed devices, e.g. superimposed MCS, new pumps.

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APPENDIX I

Tables IA and IIA refer to Table I and Table II and summarize the results of the quoted publications. The detailed description of the compression products shown in the Appendix includes brand names (printed in Italics) as quoted in the abstract of the original paper.

Comparisons between two treatment regimes are marked by A/B.

TABLE IA.—*Experimental data on compression therapy.*

Parameter	Experiment (methods)	Compression* (material/pressure)	Results	Authors	References
Edema: prevention by medical compression stockings and bandages					
Skin echogenicity MCS	Dermal water content (high resolution ultrasound) determined 3 times a day in 20 patients with lipodermatosclerosis	MCS 26-36 mmHg	MCS protect against leg swelling in standing position	Gniadecka M. Acta Derm Venereol 1995;75:120-4.	22
Skin echogenicity Bandages	High resolution ultrasound in 3 patients (C6, C5)	*Setopress* (long stretch/Comprilan (short stretch)	Higher pressure (long stretch) leads to more edema reduction	Gniadecka M *et al.* Acta Derm Venereol 2002;82:460-85.	29
Leg volume MCS	Diurnal volume changes, 114 male workers with CVI, 3 months	30-32 mmHg, *Venotrain strong; Bauerfeind*)/rubber floor mats	Less swelling and complaints with MCS	Krijnen RM *et al.* J Occup Environ Med 1997;39:889-94.	23
Capillary filtration MCS	APG, capillary filtration rate (CFR) in 29 legs with CVI	MCS, 30 mmHg: low vs high stiffness Compriform vs Bellavar vs Fast fit	High slope more effective	Van Geest AJ *et al.* Dermatol Surg 2000;26:244-7.	25

(to be continued)

TABLE IA.—*Experimental data on compression therapy (continued).*

Parameter	Experiment (methods)	Compression* (material/pressure)	Results	Authors	References
Leg volume Light support stockings	DVC of the lower legs (optical device), 5 days 118 healthy volunteers	Class I support stockings (14 vs 18 mmHg, Lycra, Dupont)/6 mmHg	Reduction of DVC and of complaints with support stockings	Jonker MJ *et al.* Dermatology 2001;203: 294-8.	19
Leg volume MCS	Water displacement Difference between evening-morning volume=edema (12 volunteers, C0-C3)	4 classes (6-25 mmHg) Sigvaris Randomly applied	Evening swelling prevented by >10 mmHg, less complaints	Partsch H *et al.* J Derm Surg 2004;30:737-43.	20
Leg volume Long haul flights MCS	10 randomized trials (n=2 856), 9 (n=2 821) compared stockings vs no stocks	Different brands of stockings 10-20 mmHg	Stockings reduce edema (based on 6 trials)	Clarke M *et al.* Cochrane Database of Systematic Reviews 2006, Issue 2.	21
Edema reduction by medical compression stockings and bandages					
Perimalleolar subcutaneous pressure MCS	S.c. pressure in normals and patients with CVI	MCS 20-30 mmHg/30-40 mmHg	Higher tissue pressure in CVI, further increased by MCS	Nehler MR *et al.* J Vasc Surg 1993;18:783-8.	123
Leg volume MCS	Leg volume (water displacement) 240 patients CVI, 12 weeks	23-32 mmHg MCS/horse chestnut seed extract	Reduction of edema by both treatments	Diehm C *et al.* Lancet 1996,347:292-4.	24
Skin echogenicity MCS	Water content in LDS and healed leg ulcers (C4-C5), 10 patients	MCS (18-26 mmHg/26 to 36 mmHg) *Sigvaris*	Removal of dermal edema with both compression classes	Gniadecka M *et al.* Removal of J Am Acad Dermatol 1998;39:966-70.	26
Leg volume MCS	Leg volume (water displacement) 341 patients, C1-C3s, 4 weeks	10-15 mmHg/placebo (3-6 mmHg)	Reduction of edema, improvement of QOL	Vayssairat M *et al.* J Mal Vasc 2000;25:256-62.	27
Leg volume MCS	Leg volumetry and capillary videoscopy, 11 patients C2-C4, 2 weeks	MCS, 23-32 mmHg	Reduction of leg volume only in the 1st week	Onorati D *et al.* J Malad Vasc 2003;28:21-3.	28
Edema reduction by intermittent pneumatic compression					
Hand volume (traumatic) IPC	Volumetry, 30 patients posttraumatic hand-edema	IPC/high voltage/0	Reduction of hand edema by IPC	Griffin JW *et al.* Phys Ther 1990;70:279-86.	30
Leg volume (traumatic) IPC	Leg circumference and CT in post-traumatic edema (after fracture), 16 patients	IPC	Edema reduction, density decreased in skin, increased in muscles	Airaksinen O *et al.* Arch Phys Med Rehabil 1991;72:667-70.	31
Leg volume (venous) IPC	Volume measurement in 27 patients with venous ankle swelling	IPC *Flowpac* (*Huntleigh*) with different settings	Lower pressures and shorter inflation and deflation times more efficient than higher pressures and inflation/deflation times	Grieveson S *et al.* J Tissue Viability 2003;13:98-100.	32

(to be continued)

TABLE IA.—*Experimental data on compression therapy (continued).*

Parameter	Experiment (methods)	Compression* (material/pressure)	Results	Authors	References
Leg volume (postoperative, traumatic) IPC	Volume measurement (water displacement), 38 patients with post-traumatic/postsurgical ankle swelling	IPC in 19 patients daily, 19 patients control	Significant reduction of edema by IPC	Myerson MS *et al.* Foot Ankle 1993;14:198-203.	33
Leg volume (traumatic) IPC	Daily circumferential ankle girth measurements in 64 patients with ankle fractures	27 patients with A-V Impulse "in-cast" system, 27 controls	Significant reduction of swelling by IPC	Caschman J *et al.* J Orthop Trauma 2004;18:596-601.	34
Venous flow velocity/influence of medical compression stockings and bandages					35
Venous flow velocity Thromboprophylactic stockings	Isotopic phlebography, Mean transit time [radioisotopes], n=12, horizontal position	MCS [10-15 mmHg]	Increase of venous flow velocity in every single case (supine)	Partsch H *et al.* Klinikarzt 1982;11:609-15.	124
Venous flow velocity MCS	Duplex 10 normals, 16 CVI	MCS calf and thigh length, 3-40 mmHg, 40-50 mmHg	Upright: modest increase of peak flow in popliteal vein	Mayberry JC *et al.* J Vasc Surg 1991;13:91-100.	125
Venous flow velocity Thromboprophylactic stockings	Duplex, peak velocity femoral vein in normals and postoperative patients	MCS with and without IPC	No increase of peak velocity with MCS	Keith SL *et al.* Arch Surg 1992;127:727-30.	126
Venous flow velocity Thromboprophylactic stockings	Doppler Popliteal vein, 10 non-pregnant females	3 types of support stockings	No significant increase of velocity	Macklon NS *et al.* Br J Radiol 1995;68:515-8.	36
Venous flow velocity MCS	Duplex Femoral vein, 10 females in late pregnancy	25 mmHg MCS	Less reduction of flow velocity by standing up	Norgren L *et al.* Vasa 1995;24:282-5.	37
Venous flow velocity MCS	Duplex Femoral vein , 17 females postpartum	Thigh length MCS	Increase of flow velocity	Jamieson R *et al.* Br J Obstet Gynaecol 2007;62:1174-9	3
Venous flow velocity/Influence of intermittent pneumatic compression					
Prevention of stasis	Medline search 1970-2002 Venous blood flow velocity measured mainly by duplex	IPC and MCS	Flow augmentation depends on speed of inflation, pressure and graded sequential compression	Morris RJ *et al.* Ann Surg 2004;239:162-71.	8
Review Venous flow velocity	Doppler, femoral and popliteal veins, 20 patients with tetraplegia	Slow SCD/fast IPC	Increase of maximal venous velocity more with IPC	Nash MS *et al.* J Spinal Cord Med 2000;23:221-7.	39

(to be continued)

TABLE IA.—*Experimental data on compression therapy (continued).*

Parameter	Experiment (methods)	Compression* (material/pressure)	Results	Authors	References
Venous flow velocity IPC	Duplex, femoral vein, 10 normals, 10 patients hip surgery	IPC *A-V Pulse*, different body positions	Increase of flow velocity, most pronounced in semi-erect	Pitto RP *et al.* Biomed Tech (Berl) 2001;46:124-8.	40
Venous flow velocity IPC	Duplex, several vein segments, several body positions, 12 normals	IPC foot/calf/calf + thigh, 40 mmHg calf, 80 mmHg foot	Increase of flow velocity, in popliteal vein especially after foot compression	Lurie F *et al.* J Vasc Surg 2003;37:137-42.	41
Venous flow velocity IPC, exercise	Duplex femoral vein, 10 normals	60 mmHg calf/ sequential plantar-calf IPC	Increase of maximum velocity, more with plantar-calf compression	Iwama H *et al.* J Crit Care 2000;15:18-21.	42
Venous flow velocity IPC	Duplex in femoral vein, 20 patients intensive care	IPC (*AV-Pulse*) 130 mmHg 2 h/15 dorsiflexions/min (by a nurse), 5 min	Increase of peak flow velocity with both methods, exercise had longer effect.	Yamashita K *et al.* J Clin Anesth 2005;17:102-5.	43
Venous flow velocity IPC	Duplex, 30 normals, supine and semi-erect	*SCD Express* [new portable device]/SCD	Similar enhancement of flow velocity	Kakkos SK *et al.* J Vasc Surg 2005;42:296-303.	44
Venous flow velocity IPC	Duplex, 12 normals in semi-erect position	*SCD* (sensing venous refill)/*Venaflow Aircast* (fast inflating)	Higher peak velocity with fast system, but lower volume of blood/h	Kakkos SK *et al.* Int Angiol 2005;24:330-5.	45
Venous flow velocity IPC, bandage	Doppler femoral vein, 20 normals	Rapidly inflating/ slowly inflating machines	Higher peak flow velocity with rapid system	Morris RJ *et al.* J Vasc Surg 2006;44:1039-45.	46
Venous flow velocity IPC	Duplex, popliteal vein, 20 legs with C6	4 layer bandage/+ SCD device/0	Increase of peak flow velocity by SCD	Kalodiki E *et al.* Eur J Vasc Endovasc Surg 2007;33:483-7.	47
Venous flow velocity IPC	Doppler 22 normals	Aviafit (new battery driven foot pump)	Increase of peak flow velocity	Galili O *et al.* Thromb Res 2007; 121:37-41	48
Venous diameter by medical compression stockings and bandages					
Venous diameter Prophylactic stockings	Duplex Gastrocnemius veins during general surgery n=40	Anti-embolism stockings/0	Intraoperative venous distension reduced	Coleridge Smith PD *et al.* Br J Surg 1991;78:724-6.	49
Venous diameter (thigh) MCS, Pneumatic cuff	Duplex Femoral and great saphenous vein (thigh), 12 patients, C6	Blood pressure cuff, 23-32 mmHg MCS	Compression of thigh veins only with a local pressure >40mmHg	Partsch H et al J Vasc Surg 2002;36:948-52.	50
Venous diameter MCS	Duplex superficial and deep veins, supine and standing	MCS 20-30 mmHg	No diameter reduction in standing, only in supine	Lord RS *et al.* ANZ J Surg 2004;74:581-5.	127
Venous diameter	Duplex superficial and deep leg veins,	Inflatable cuff	Complete venous occlusion with 20	Partsch B *et al.* J Vasc Surg: 2005;42: 734-8.	51

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TABLE IA.—*Experimental data on compression therapy (continued).*

Parameter	Experiment (methods)	Compression* (material/pressure)	Results	Authors	References
Pneumatic cuff	supine and standing		mmHg in supine, 70 mmHg in standing		
Venous diameter (thigh) MCS	Duplex Femoral vein, 17 females postpartum	Thigh length MCS	Reduction of diameter of femoral vein	Jamieson R *et al.* Br J Obstet Gynaecol 2007;62;1174-9.	37
Venous reflux reduction by medical compression stockings and bandages					
Venous reflux Pressure cuff	Duplex Upright position 36 patients with reflux	Inflatable, water-filled cuff	Refluxes abolished in 4/17 patients with popliteal vein reflux by 60 mmHg	Sarin S *et al.* Br J Surg 1992;79:1385-6.	52
Venous reflux MCS, Velcro band-device	APG (venous filling index)	MCS 30-40 mmHg/Circaid	Reduction of reflux more with Circaid	Spence RK *et al.* J Vasc Surg 1996;24: 783-7.	53
Venous reflux MCS, bandages	APG (venous filling index) 21 patients, C6,deep refluxes	4-layer, MCS, inelastic Band/20-60 mmHg	Reduction of reflux >40 mmHg, inelastic more effective than elastic	Partsch H *et al.* Dermatol Surg 1999;25: 695-700.	54
Venous reflux MCS, bandages	Duplex: reflux velocity popliteal vein in standing 60 patients	MCS 23-46 mmHg (Venofit)/short stretch bandages (Comprilan)	Decrease of maximal reflux velocity by MCS and bandage	Evers, EJ *et al.* Vasa 1999;28:19-23.	55
Venous pump improvement by medical compression stockings and bandages					
Venous pump MCS	Foot volumetry, 37 patients with CVI	MCS Sigvaris	Improved venous pump in most patients	Gjöres JE *et al.* Vasa 1977;6:364-8.	56
Venous pump MCS	Foot volumetry 10 normals, 10 varicose veins, 10 with post-thrombotic syndrome	Light NHS stocks/Sigvaris medium/Sigv strong	Improved venous pumping with Sigvaris med and strong	Jones NAG *et al.* Br J Surg 1980;67:569-72.	57
Venous pump MCS	Foot volumetry, 20 patients with CVI	MCS 5 brands, 10-40 mmHg Sigvaris	Increase of expelled volume with higher pressure, no change of refilling time	Partsch H. Vasa 1984;13:52-7.	58
Venous pump MCS	APG	MCS	Improved venous pumping	Christopoulos DG *et al.* J Vasc Surg 1987;5:148-55.	59
Venous pump MCS	Foot volumetry, PPG, strain gauge plethysmography	MCS	No improvement of refilling time	Norgren L. Acta Chir Scand 1988;154:505-7.	60
Venous pump MCS	Strain gauge plethysmography, duplex 15 pregnant women	MCS 25-32 mmHg/0	Improvement of venous pump, longer refilling time	Büchtemann AS *et al.* Br J Obstet Gynecol 1999;106:563-9.	61
Venous pump MCS	RVF (APG), treadmill 10 patients C2-C4	MCS 21 mmHg/0	Reduction of RVF independent of walking speed	Ibegbuna V *et al.* J Vasc Surg 2003;37: 420-5.	62

(to be continued)

TABLE IA.—*Experimental data on compression therapy (continued).*

Parameter	Experiment (methods)	Compression* (material/pressure)	Results	Authors	References
Ambulatory venous hypertension/influence of medical compression stockings and bandages					
Venous pressure MCS	Pressure in a dorsal foot vein, 11 patients PTS	MCS 30-40 mmHg	Reduction of systolic peak pressure	O'Donnell TF Jr *et al.* JAMA 179;242: 2766-8.	64
Venous pressure MCS, bandages	Pressure in a dorsal foot vein, 13 patients with CVI	MCS 10-15 mmHg/elastic/inelastic bandages >50 mmHg	Reduction of mean venous hypertension by inelast.bandages >50 mmHg, not by MCS	Partsch H. VASA 1984;13:58-64.	63
Venous pressure MCS		MCS 20-30 mmHg	No change refill time	Christopoulos DG *et al.* J Vasc Surg 1987;5:148-55.	59
Venous pressure MCS	Pressure in a dorsal foot vein, 16 patients CVI	MCS calf and thigh length, 30-40 mmHg, 40-50 mmHg	No significant improvement	Mayberry JC *et al.* J Vasc Surg 1991;13: 91-100.	124
Decubitus	LDF	Pressure of trochanter produced by indenter in healthy people	Increase of dermal blood flow with pressure 60 mmHg	Xakellis GC *et al.* J Gerontol 1993;48: M6-9.	128
Decubitus	Laser Doppler and thermometry over sacrum and gluteus 30 normals	Indenter 0-110 mmHg	Decrease of LDF over a pressure of 50 mmHg	Schubert V *et al.* Clin Physiol 1989;9: 535-45.	129
Decubitus	LDF over the heel, 10 normals,10 patients	Indenter, compression forces 50-1 500 g	Pressure >50 mmHg reduced LDF to a minimal value	Abu-Own A *et al.* Eur J Vasc Endovasc Surg 1995;9:327-34.	130
Decubitus	LDF over heel and dorsum of foot, 12 normals	Support load 20 mmHg 5 min	Reduced average skin blood perfusion attributable to blunting of hyperemia	Mayrovitz HN *et al.* Adv Skin Wound Care 2004;17:197-201.	131
Leg blood flow, bandages	Laser Doppler distal to the bandage (toe) and under the bandage	Bandages: zinc paste, elastic wrap 32 (28) mmHg	No reduction of sub-bandage perfusion, but of toe perfusion	Mayrovitz HN. Clin Physiol 1998,18:117-24.	132
Leg blood flow, bandages	Arterial pulsatile flow, nuclear magnetic resonance flowmetry, 8 normal legs	Bandages: Zinc paste + *Coban, Coban* 38 mmHg	Increase of blood perfusion	Mayrovitz HN *et al.* Ostomy Wound Manage 1998;44:56-67.	66
Arm blood flow MCS	Venous occlusion plethysmography normal forearms (n=9)	MCS 13-23 mmHg for 10 min	Increase of blood flow up to 30 min	Bochmann RP *et al.* J Appl Physiol 2005;99:2337-44.	65
Arterial flow/influence of intermittent pneumatic compression					
Arterial flow	Duplex popliteal artery, 4 patients	IPC 20-120 mmHg, prone and sitting	Increase of arterial flow especially in sit-	van Bemmelen PS *et al.* Vasc Surg	67

(to be continued)

TABLE IA.—*Experimental data on compression therapy (continued).*

Parameter	Experiment (methods)	Compression* (material/pressure)	Results	Authors	References
IPC	with arterial occlusive disease, 11 normals		ting position	1994;19:1052-8.	
Arterial flow IPC	Duplex popliteal artery, 30 volunteers	Intermittent pneumatic foot and calf compression	Increase of popliteal blood flow	Labropoulos N *et al.* Arch Surg 1998;133:1072-5.	68
Arterial flow IPC	Duplex popliteal artery, 25 normals, 40 limbs of 32 stable claudicants	IPC (foot): 120 mmHg, inflation time: 3 s; deflation time: 17 s	Augmentation of arterial inflow in normals and claudicants	Delis KT *et al.* Eur J Vasc Endovasc Surg 2000;19:250-60.	69
Arterial flow IPC	Duplex, popliteal artery, sitting , 25 normal limbs, 31 limbs with claudication	IPC (foot), IPC (calf), or both	IPC (foot+calf) is most effective in augmenting arterial calf inflow in patients and normals	Delis KT *et al.* J Vasc Surg 2000;32:284-92.	70
Arterial flow IPC	Walking distance, ABPI in 37 claudicants	IPC (foot) >4 h/d, 4-5 months in 25 patients, 12 controls	Increase of walking distance and of ABPI	Delis KT *et al.* J Vasc Surg 2000;31:650-61.	71
Arterial flow IPC	Duplex, femoral artery, 19 normals	IPC 10 s/1 min compression	Higher and longer hyperemia with longer compression	Morris RJ. Clin Physiol Funct Imaging 2004;24:237-42.	72
Arterial flow IPC	Duplex in autologous arterial grafts, 18 femoro-popliteal, 18 femoro-distal	IPC (foot), IPC (calf) or both	Enhancement of arterial flow parameters, most effective: IPC (foot+calf)	Delis KT *et al.* Br J Surg 2004;91:429-34.	73
Arterial flow IPC	Duplex and laser Doppler in 20 limbs with critical ischemia	IPC 120 mmHg for 3 s, 3/min	Increase of arterial flow and of LDF	Labropoulos N *et al.* J Vasc Surg 2005;42:710-6.	74
Arterial flow IPC	Duplex, popliteal artery, 26 limbs with arterial occlusions, 24 normal limbs	IPC (foot), IPC (calf), or both	Leg inflow enhancement exceeds 50 s in claudicants and lasts 32.5 to 40 s in the controls	Delis KT *et al.* J Vasc Surg 2005;42:717-25.	75
Arterial flow IPC	Walking distance, ABPI in 30 patients with claudication	Fast IPC calf and foot for 1 h twice daily in sitting (15 patients)/walking exercise (15 patients)	IPC improves walking distance, sustained at 1 year	Ramaswami G *et al.* J Vasc Surg 2005;41:794-801.	76
Microcirculation/influence of medical compression stockings and bandages					
Blood cell velocity, pressure cuff	LDF 15 patients with lipodermatosclerosis, 15 normals	Blood pressure cuff 10-100 mmHg	Increase of LDF with pressure up to 20 mmHg (supine), up to 60 mmHg (sitting)	Abu-Own A *et al.* J Vasc Surg 1994;19:1074-83.	77
Fibrinolytic activity	Euglobulin lysis time, t-PA antigen,	Elastic bandage on upper limb/lower	No profibrinolytic effect of elastic com-	Conchonnet P *et al.* Blood Coagul Fibri-	133

(to be continued)

TABLE IA.—*Experimental data on compression therapy (continued).*

Parameter	Experiment (methods)	Compression* (material/pressure)	Results	Authors	References
	PAI-1 antigen, PAI-1 activity in 21 normals	limb/0	pression	nolysis 1994;5:949-53.	
Dermal clearance	Densitometry after intracutaneous injection of sodium fluorescein, 10 normals, 20 C4-C5	MCS 30 mmHg	Improvement of venolymphatic drainage	Lentner A *et al.* Int J Microcirc Clin Exp 1996;16:320-4.	78
Capillary morphology, Bandages, MCS	Video capillary microscopy after 4 weeks of compression, 20 patients CVI	2 weeks bandages, then 2 weeks MCS	Increase in capillary density, decrease in capillary diameter and pericapillary halo diameter.	Klyscz T *et al.* Hautarzt 1997;48:806-11.	79
Capillary morphology, MCS	Fluorescence video microscopy, intravital video capillaroscopy, TcpO2 and laser Doppler flowmetry, 20 patients CVI	MCS 4 weeks	Increase of nutritive capillaries, diameter reduction of capillaries and dermal papillae	Jünger M *et al.* Microcirculation 2000;7:3-12.	80
Pericapillary halo	Video-capillaroscopy (and leg-volumetry), 2 weeks, 11 patients C2-C4	MCS, 23-32 mmHg	Reduction of pericapillary edema	Onorati D *et al.* J Mal Vasc. 2003;28: 21-3	28
Tissue oxygenation	NIRS 10 patients CVI	MCS 14-35 mmHg in different body positions	Improving deeper tissue oxygenation during walking with strong MCS	Agu O. Vascular 2004;12:69-76.	81
Capillary filtration, tcPO2	tcPO2/TcPCO2	Review on effects of drugs and compression	Capillary filtration? tcPO2?	Wollina U. Int J Low Extrem Wounds 2006; 5:169-80.	82
Tight junctions	Skin specimens, expression pattern of TJs-molecules in healthy persons and patients with CVI	MCS	Tightens the paracellular barrier via elevated expression of specific TJs	Herouy Y *et al.* Int J Mol Med 2006;18: 215-9.	83
Microcirculation/influence of intermittent pneumatic compression					
Tissue oxygenation	tcPO2 in 10 patients with post-thrombotic ulcers (C6), 9 controls	IPC	Increase of oxygen tension	Kolari PJ *et al.* Cardiovasc Res 1988;22:138-41.	84
Skin blood flow	Skin perfusion of the great toe laser Doppler, in 50 normal limbs	*Art-assist AA 1000*, sitting position	The majority of increased perfusion is from increased arterial inflow	Eze AR *et al.* Ann Vasc Surg 1998;12: 182-6.	85
Skin blood flow	Laser Doppler on distal forefoot in 16 limbs with severe infrapopliteal arterial occlusions, 13 normals	IPC (*Art Assist*)	Increased skin-flux	van Bemmelen PS *et al.* Vasa 2000;29:47-52.	86

(to be continued)

TABLE IA.—*Experimental data on compression therapy (continued).*

Parameter	Experiment (methods)	Compression* (material/pressure)	Results	Authors	References
Tissue oxygenation, skin blood flow	LDF and tcPO2 in 8 normals	IPC	Increase of LDF and tcPo2	Pekanmäki K *et al.* Vasa 1991;20:394-7.	87
Skin blood flow and skin oxygenation	LDF, tcPo2 on big toe, 15 normals, 15 patients with arterial occlusive disease	Pneumatic foot pump, different body positions	Increase of LDF and tcPo2 in sitting	Abu-Own A *et al.* J Vasc Surg 1994;19:1074-83.	77
Endothelium derived mediators	Expression of fibrinolytic factors and several mediators on an in vitro cell culture system (venous flow simulator)	Simulating blood flow and vessel collapse conditions during IPC	IPC upregulates EC fibrinolytic potential and influences vasomotor tone	Dai G *et al.* J Vasc Surg 2000;32:977-87.	88
Endothelium derived mediators	IPC-induced vasodilation and endothelial NOS (eNOS) expression in upstream muscle	IPC	eNOS plays an important role in regulating the micro-circulation in upstream muscle	Chen LE *et al.* J Appl Physiol 2002;92:559-66.	89
Diameter of muscular arterioles	Diameter of muscle arterioles in cremaster muscle from 80 rats	IPC 60 min, both legs (distally)	Increased release of nitric oxide causing systemic vasodilation	Liu K *et al.* J Orthop Res 1999;17:88-95.	90
Bone mineral densitiy	X-ray absorptiometry, femoral neck in 37 postmenopausal women	IPC 2 h/day, 6 months	Increase of bone mineral density	Albertazzi P *et al.* Bone 2005;37:662-8.	134
Bone scan	[99mTc]MDP uptake in 24 patients	IPC 60 mmHg for 1 h	Increased uptake of [99mTc]MDP in long bones	Morris RJ *et al.* Arch Orthop Trauma Surg 2005;125:348-54.	135
Fibrinolytic activity	Euglobulin lysis time, urokinase plasminogen activator, t-PA 19 patients CVI	IPC twice weekly 2 h, 13 weeks	Enhancement of fibrinolysis in 86%	Kessler CM *et al.* Blood Coagul Fibrinolysis 1996;7:437-46.	136
Fibrinolytic activity	tPA Ag and Act, PAI-1 α-2-antiplasmin-plasmin complexes, vWF antigen in 6 normals, 6 patients PTS	5 IPC devices applied for 120 min in random fashion, 1 per week x 5 weeks	Elevation in fibrinolytic activity at 180 min with all devices in normal subjects and post-thrombotic	Comerota AJ *et al.* Ann Surg 1997;226:306-13.	137
Fibrinolytic activity	Fibrinolytic activity after hip replacement	25 patients with IPC, 25 without IPC I	No difference in systemic fibrinolysis	Macaulay W *et al.* Clin Orthop 2002;399:168-76.	138
Fibrinolytic activity	tPA and PAI-1 from common femoral vein for measurement of regional fibrinolysis; 45 patients with major abdominal surgery	PC/heparin s.c./or both up to 5 days IPC 120 min	No significant enhancement of local fibrinolysis in any group	Killewich LA *et al.* J Vasc Surg 2002;36:953-8.	139

(to be continued)

TABLE IA.—*Experimental data on compression therapy (continued).*

Parameter	Experiment (methods)	Compression* (material/pressure)	Results	Authors	References
Fibrinolytic activity	uPA ,tPA and PAI-1 21 healthy males	Rapidly inflating IPC	IPC enhances fibrinolysis and suppresses procoagulant activation	Giddings JC *et al.* Clin Lab Haematol 2004;26:269-73.	140
Fibrinolytic activity	Analysis of blood coagulation and fibrinolytic potential in 20 healthy males	IPC/gently inflating system 2 h	Suppression of procoagulant activation, rapid system not superior	Morris RJ *et al.* J Vasc Surg 2006;44: 1039-45.	46
Lymphedema/influence of medical compression stockings and bandagesc					
Volume reduction animal model (Wistar rats)	Limb circumferences (truncated cone method)	Control/Coban/MLD /IPC/combination	Edema reduction with compression	Kriederman B *et al.* Lymphology 2002; 35:23-7.	91
Pressure in lymph capillaries	Fluorescence microlymphography and pressure measurements in cutaneous lymph capillaries, 12 patients with lymphedema	Complex physical therapy 2 weeks bandages	Lymph pressure? after 2 weeks and 3 months	Franzeck UK *et al.* J Vasc Res 1997;34: 306-11.	92
Spontaneous contractions of lymph collectors	Intralymphatic flow and pressure measurement	Cuff, massage	Increase of lymphatic pulsations	Olszewski W. Boca Raton: CRC Press; 1991.	93
Cytokines and receptors for growth factors	Quantitative expression of the upregulated pro-inflammatory cytokines and receptors for growth factors	Complex physical decongestion therapy	Down-regulation of cytokines	Földi E et al Lymphology 2000;33:19-23.	94
Lymphedema/influence of intermittent pneumatic compression					
Protein re-absorption	Labeled albumin uptake	Single and multichamber IPC	Increase of protein uptake	Leduc A *et al.* In: Partsch H, editor. Amsterdam: Excerpta Medica; 1988.p. 591-2.	95
Removal of protein	Labeled albumin i.v., limb volumetry	IPC	Increase of oncotic tissue pressure	Partsch H *et al.* Z Lymphologie 1981;5:35-9.	96
Volume reduction, lymph transport	Volume measurement and isotopic lymphography, 11 patients	IPC 3 h, measurements before and 48 h later	Volume decrease, no improvement of lymph-scan	Miranda F Jr *et al.* Lymphology 2001;34:135-41.	97

MCS: medical compression stockings; CVI: chronic venous insufficiency; APG: air plethysmography; DVC: diurnal volume change; LDS: lipodermatosclerosis; QOL: quality of life; IPC: intermittent pneumatic compression; SCD: sequential compression device; PPG: photoplethysmography; RVF: residual volume fraction; PTS: post-thrombotic syndrome; LDF: laser Doppler fluxmetry; ABPI: ankle brachial pressure index; TJ: tight junctions; NOS: nitric oxide synthase; MDP: methylene diphosphonate; Ag: antigen; tPA: global fibrinolytic activity; Act: activity; PAI-1: plasminogen activator activity.

TABLE IIA.—*Outcome of RCTs and meta-analyses using medical compression stockings and bandages.*

Indication	Comparison	Outcome	Grade	Authors	Reference
Chronic venous disorders CEAP C0-C6)					
C0S, C1 S MCS	0/ 8-15/15-20 mmHg *L'eggs, JC Penny*	Light compression improves symptoms	2B	Weiss RA *et al.* Derm Surg 1999;25:701-4.	141
C0S, C1 S MCS	10-15/6 (Placebo) mmHg *Innothera, Paris*	Improvement of QOL and edema	1B	Vayssairat M *et al.* J Mal Vasc 2000;25:256-62.	98
C0S, C1 S MCS	10-15/6 (Placebo) mmHg *microfibres+Elasthan+Co tton*	Improvement of QOL and pain	1B	Benigni JP *et al.* Phlébologie 2003;56:117-25.	99
C1 sclero MCS	0/3/7/21 days *(10-20 mmHg) Sigvaris*	Better vein resolution, less pigmentation	2B	Weiss RA *et al.* Dermatol Surg 1999;25:105-8.	142
C1 sclero MCS	0/21 days *(20-30 mmHg) Sigvaris*	Better vein resolution, less pigmentation	1B	Kern P *et al.* J Vasc Surg 2007;45:1212-6.	100
C1 sclero MCS	35-40 mmHg/Bandage *Struva medi vs Elastocrepe*	Stocking: better results, fewer side effects	1B	Scurr JH *et al.* Ann Roy Coll Surg Engl 1985;67:109-11.	108
C2A MCS	30 mmHg+ physical therapy/0 *Varisma, Viso*	Better venous function	2B	Hartmann BR *et al.* Angiology 1997;48:157-62.	143
C2S MCS	30-40 mmHg+drug/drug/plac *Sigvaris 503*	Drug+stocking best for symptoms (VAS)	2B	Anderson JH *et al.* Phlebology 1990;5:271-6.	144
C2S pregnancy MCS	0/18-21/25-32 mmHg *Sigvaris*	Symptoms improved, no influence on progression	1B	Thaler E *et al.* Swiss Med Wkly 2001;131:659-62.	101
C2 after surgery MCS/band	15/40 mmHg, 3 weeks *Brevet (MCS) vs Brevet Varex (bandage)*	No difference bruising, phlebitis, 15 mmHg more comfort	1B	Shouler PJ *et al.* Ann Roy Coll Surg Engl 1989;71:402-4.	145
C2 after surgery MCS	20-30 mmHg/0 *medi*	Recurrence after 1 year reduced by MCS	2B	Travers JP *et al.* Phlebology 1994;9:104-9.	146
C2 after surgery MCS	7d *Dauerbinde*, then *Tubigrip* for 1, 3, 6 weeks	Wear time: no difference on symptoms and side effects	2B	Rodrigus I *et al.* Phlebology 1991;6:95-8.	147
C2 after surgery MCS/band MCS	TED 10-12/30-40/Band. 1 wk *TED vs Medi vs Panelast (Lohmann)*	Pain and costs: no difference	2B	Bond R *et al.* Phlebology 1999;14:9-11.	148
C2 after surgery MCS/band	Band 1 week/crepe 16 h/ then TED 6 weeks *TED, Panelast (Lohmann)*	Day 1: less pain, week 1: less bleeding with Panelast	2B	Raraty MGT *et al.* Phlebology 1999;14:21-5.	149
C2 after surgery MCS/band	Crepe/elastocrepe-Bandage /20-30 mmHg *Venosan, Salzmann*	Pressure loss of bandages, not of MCS	1B	Coleridge- Smith PD *et al.* Phlebology 1987;2: 165-72.	150
C2 after surgery band/band	Crepe 1 day/Bandage 6 days *Panelast (Lohmann)*	Panelast less bleeding (labeled RBC) than Crepe bandage	1B	Travers JP *et al.* Ann Roy Coll Surg Engl 1993;75: 119-22.	109

(to be continued)

TABLE IIA.—*Outcome of RCTs and meta-analyses using medical compression stockings and bandages (continued).*

Indication	Comparison	Outcome	Grade	Authors	Reference
C2 after surgery MCS	Postoperative bandage for 3days, then TED 1 week/3 weeks	3 weeks TED not better than 1 week	2B	Biswas S *et al.* Eur J Vasc Endovasc Surg 2007;33: 631-7.	151
C2 sclerotherapy MCS/band	40 mmHg/15 mmHg *Brevet Varex vs Elastocrepe*	No difference bruising, phlebitis, 15 mmHg more comfort	2B	Shouler PJ *et al.* Ann Roy Coll Surg Engl 1989;71:402-4.	145
C2 sclerotherapy MCS/band	35-40 mmHg MCS/bandage 18 days *Struwa forte medi vs Elastocrepe*	MCS better than Elastocrepe, better results, less side effects	1B	Scurr JH *et al.* Ann Roy Coll Surg Engl 1985;67: 109-11.	108
C3 prevention (flight) MCS	Review 10 RCTs (n=2 856) 10-20 mmHg MCS/0 *Scholl, Sigvaris, Kendall, medi*	Leg edema prevented by stockings	1B	Clarke M *et al.* Cochrane Database of Systematic Reviews 2006, Issue 2.	21
C3 prevention MCS	30-40 mmHg/drug	Reduction of leg volume (12 weeks) comparable to drug	2B	Diehm C *et al.* Lancet 1996,347:292-4.	24
C4b (LDS) MCS	30-40 mmHg/0 *Venosan, Salzmann*	Significant reduction of LDS by MCS	1B	Vandongen YK *et al.* Phlebology 2000;15:33-7. 103.	102
C5 MCS	Review 2 RCTs: A)300 patients 18-24 mmHg/25-35 mmHg B)166 patients two brands of 18-24 mmHg 20-40 mmHg MCS	MCS reduce recurrence rate, higher pressure better. Higher recurrence with non-compliance	A	Nelson E A, 2000 The Cochrane Library, 1, 2002.Oxford: Update Software	103
C5 MCS	18-24 mmHg/25-35 mmHg	High pressure: lower recurrence rate	1B	Nelson E A, J Vasc Surg 2006 44:803-8	152
C6 Bandages, MCS	Systematic review, 22 trials reporting 24 comparisons	Compression more effective than no compression. Multilayer more effective than single-layer High pressure better than low pressure	1A	Cullum N *et al.* In: The Cochrane Library, Issue 2, 2002. Oxford: Update software.	107
C6 Bandages	4 layer *Profore*/2 short stretch *Rosidal K*	No difference 12 weeks healing	1B	Partsch H *et al.* Vasa 2001;30:108-13.	153
C6 Bandages	Zinc paste + *Tensopress*/Zinc paste + *Elastocrepe* bandages	No difference after 26 weeks	1B	Meyer FJ *et al.* Br J Surg 2002;89:40-4.	154
C6 Bandages	3 layer paste/4 layer bandage	Paste bandages higher healing rate after 20 weeks	1B	Meyer FJ *et al.* Br J Surg 2003;90:934-40.	155
C6 Bandages	2 layer *Surepress*/ 4 layer *Profore* bandages	No difference in rate of closure at 24 weeks, at 12 weeks Profore better	1B	Moffatt CJ *et al.* Wound Repair Regen 2003;11:166-71.	156
C6 Bandages	4 layer *Profore*/usual system of care	4L higher and faster healing rates after 12 weeks, reduction costs	1B	O'Brien JF *et al.* Br J Surg 2003;90:794-8.	157

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TABLE IIA.—*Outcome of RCTs and meta-analyses using medical compression stockings and bandages (continued).*

Indication	Comparison	Outcome	Grade	Authors	Reference
C6 Bandages	4 layer *Profore*/short stretch *Comprilan*	4 layer Profore faster healing	1B*	Ukat A *et al.* J Wound Care 2003;12:139-43.	158
C6 Bandages	4 Layer Profore/Unna boot bandages	Equally effective 24 weeks	1B	Polignano R *et al.* J Wound Care 2004;13:21-4.	159
C6 Bandages	Cohesive short stretch (*Actico Flexiban*)/4 layer bandages	Equal results healing, even in pt2 with mobility deficit	1B	Franks PJ *et al.* Wound Repair Regen 2004;12: 157-62.	160
C6 Bandages	*Comprilan* or *Rosidal/ Profore* bandages, system 4, original 4 layer	4 L faster healing (adjusted analysis)	1B*	Nelson EA *et al.* Br J Surg 2004;91:1292-9.	161
C6 Bandages	"4 layer" (Vaseline gauze, thick gauze, felt pad, 15 cm wide "elastic bandage"/*Circaid* (non-elastic)	Circaid faster healing rates, equal girth reduction	1B	Blecken SR *et al.* J Vasc Surg 2005;42:1150-5.	162
C6 Bandages/ MCS	Stocking 20-30 mmHg + hydrocolloid *Comfeel*/ Unna boot bandage	Equally effective	2B	Koksal C *et al.* Swiss Med Wkly 2003;133:364-8.	163
C6 Band/MCS	*Venotrain Ulcertec* stocking/2 Roselastic bandages	Stocking higher healing rate, not faster	1B	Jünger M *et al.* Current Med Res Opin 2004;20: 1613-24.	104
C6 Band/MCS	*Tubulcus (Rosidal mobil)/ 1 Rosidal K* bandage	Stocking higher healing rate	1B	Jünger M *et al.* Wounds 2004;16:313-20.	105
C6 Band/MCS + bandage	*Tubulcus + elastic bandage/elastic bandage*	Higher healing rate Tubulcus+bandage, lower recurrence rate Tubulcus vs class II stocking	1B	Milic DJ *et al.* J Vasc Surg 2007;46:750-5.	106
C6 Bandages/local therapy	*Profore/Rosidal sys/local usual care* 180 patients	12 weeks healing: 76% short stretch, 78% four layer, 31% local care	1B	Wong KYI. The Nethersole School of Nursing. The Chinese University of Hong Kong, HKSAR, China; 2007.	164
IPC					
C6 IPC review	4 RCTs reviewed	Not conclusive, further trials needed	2B	Mani R *et al.* The Cochrane Library, Issue 2, 2002. Oxford: Update Software.	165
C6 IPC/IPC	Rapid IPC/slow IPC	Rapid IPC more effective than slow IPC Leg volume decrease,	1B	Nikolovska S *et al.* Med Sci Monit 2005;11:CR337-43.	166
C6 IPC/bandage	High stretch bandage (*Setopress*)/IPC (*Flowtron*, HNE Healthcare) 16 C6 patients, 11 evaluated	No difference between bandage and IPC	2B	Rowland J. Aust N Z J Surg 2000;70:110-3.	167
IPC	Systematic review 487 patients after hip surgery, 5 trials using pumps	DVT (16/221) (7%) vs 52/229 (22%); Caveat: methodological flaws,	1B	Handoll HH *et al.* Cochrane Database Syst Rev 2000;27:CD000305.	168

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TABLE IIA.—*Outcome of RCTs and meta-analyses using medical compression stockings and bandages (continued).*

Indication	Comparison	Outcome	Grade	Authors	Reference
DVT prevention					
MCS	Systematic review: A) 7 RCTs MCS alone (n=1 027), B) 9 RCTs on a background with other methods (n=1 184), most based on fibrinogen uptake tests	A) DVT 15%/29% in control group B) 3% vs 14 % in control group	1A	Amaragiri SV *et al.* Cochrane Database of Systematic Reviews 2000, Issue 1.	110
IPC, MCS	Consensus statement RCTs with mutiple comparisons (MCS, IPC, drugs)	Mechanical methods in addition to pharmacological prevention, methods of choice in high bleeding risk	1A	Nicolaides AN *et al.* Int Angiol 2006;25:101-61.	111
IPC, MCS	Systematic review	Mechanical methods reduce the risk of DVT used as monotherapy or added to a pharmacological method	1A	Roderick P *et al.* Health Technol Assess 2005;9:1-78.	112
DVT theraspy					
DVT therapy Band/MCS	Zinc paste band/MCS 34-46mmHg/0 *Varicex F+Rosidal K/Sigvaris 503*	Reduction of pain and swelling improved by compression	1B	Blättler W *et al.* Int Angiol 2003;22:393-400.	113
DVT therapy Band	Bandage/0 *Porelast*	Equal safety (pulmonary embolism)	1B	Aschwanden M *et al.* Thromb Haemost 2001;85:42-6.	115
DVT therapy MCS	MCS immediately after DVT/after 2 weeks, n=73	More recanalized venous segments with immediate compression	1B	Arpaia G *et al.* Blood Coagul Fibrinolysis 2007;18:131-7.	114
DVT therapy Bandages	Lower leg+ thigh bandages/bed rest. Endpoints: pulmonary embolism, progression of thrombosis, nosocomial infections and/or serious adverse events in 103 patients with proximal DVT	Better outcome in mobile patients: 13.5% in the mobile group (n=52) vs 28.0% in the immobile group (n=50) had adverse events	1B	Jünger M *et al.* Curr Med Res Opin 2006;22:593-602.	116
PTS prevention					
PTS prevention MCS	MCS 30-40 mmHg/0 *Varitex*	Custom made knee length Reduce PTS	1A	Brandjes DPM *et al.* Lancet 1997;349:759-62.	117
PTS prevention MCS	MCS 20-30 mmHg/placebo	No significant difference	2B	Ginsberg JS *et al.* Arch Intern Med 2001;161:2105-9.	169
PTS prevention MCS	MCS 30-40 mmHg/0	Ready made knee length MCS reduce PTS	1A	Prandoni P *et al.* Ann Intern Med 2004;141:249-56.	118

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TABLE IIA.—*Outcome of RCTs and meta-analyses using medical compression stockings and bandages (continued).*

Indication	Comparison	Outcome	Grade	Authors	Reference
PTS therapy					
PTS Therapy IPC, MCS	Review 2 RCTs: IPC 15 mmHg/50 mmHg MCS 40 mmHg/placebo	IPC: 50 mmHg better than 15 mmHg. No clear proof for MCS	1B	Kolbach DN *et al.* In: The Cochrane Library, Issue 3, 2004.	119
Lymphedema					
Lymphedema	Review Physical therapies 3 RCTs 150 patients	MCS beneficial, manual lymph drainage no extra-benefit. Bandage + MCS better than MCS	1B	Badger C *et al.* The Cochrane Library, Issue 2, 2003. Oxford: Update Software.	120
Lymphedema Band/MCS	Bandages/MCS	Inelastic bandage reduce volume more than MCS	1B	Badger CM *et al.* Cancer 2000;88:2832-7.	121
Lymphedema Bandages	Band/band+MLD	Mild additive effect of MLD on volume reduction	1B	McNeely ML *et al.* Breast Cancer Res Treat 2004;86:95-106.	170
Lymphedema IPC	IPC+DLT/DLT alone, 23 patients breast cancer	Additional mean volume reduction by IPC	1B	Szuba A *et al.* Cancer 2002;95:2260-7.	122

RCTs: randomized clinical trials; QOL: quality of life; VAS: visual analog scale; RBC: red blood cell; TED: thrombo-embolism deterrent; LDS: lipodermatosclerosis; MCS: medical compression stockings. IPC: intermittent pneumatic compression; DVT: deep vein thrombosis; MLD: minimal luminal diameter; DLT: decongestive lymphatic therapy; PTS: post-thrombotic syndrome.