Black holes in compression therapy: A quest for data

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ABSTRACT

Objective: Although compression therapy (CT) is considered a crucial conservative treatment in chronic venous disease, strong evidence is missing for many clinical indications. This literature review aims to point out what strong evidence we have for CT and all the clinical scenarios where strong evidence still needs to be included.

Methods: The research was conducted on MEDLINE with PubMed, Scopus and Web of Science. The time range was set between January 1980 and October 2022. Only articles in English were included.

Results: The main problem with CT is the low scientific quality of many studies on compression. Consequently, we have robust data on the effectiveness of CT only for advanced venous insufficiency (C3-C6), deep vein thrombosis and lymphedema. We have data on the efficacy of compression for venous symptoms control and in sports recovery, but the low quality of studies cannot result in a strong recommendation. For compression in postvenous procedures, superficial venous thrombosis, thromboprophylaxis, post-thrombotic syndrome prevention and treatment, and sports performance, we have either no data or very debated data not allowing any recommendation.

Conclusions: We need high-level scientific studies to assess if CT can be effective or definitely ineffective in the clinical indications where we still have a paucity of or contrasting data. (J Vasc Surg Venous Lymphat Disord 2023;■:101733.)

Keywords: Compression therapy; Medical compression stockings; Elastic compression; Inelastic compression; Adjustable compression wraps; Chronic venous disease

Compression therapy (CT) is one of the most effective conservative treatments for lymphatic and chronic venous disease (CVD). Many publications report its effectiveness, unfortunately often burdened with many methodological flaws leading to a low scientific level and resulting in scarce or no evidence. Critical issues concerning CT include not only a lack of reliable scientific data in many clinical indications, but also poor education in applying compression devices, especially relating to inelastic bandages (IBs), and a lack of compression devices easy to use by the health care professionals and by the patients themselves so to allow self-management and to increase compliance. This literature review aims to find the areas where data on the effectiveness of CT exist and areas where they are missing, scarce, or still debated.

METHODS

Our literature research was conducted on MEDLINE with PubMed, Scopus and Web of Science. Keywords were selected using PubMed's medical subject headings (MeSH) and MeSH/EMTREE for Scopus. The keywords 'chronic venous disease,' 'chronic venous; insufficiency,' 'spyder veins,' 'varicose vein,' 'leg edema,' 'lipodermatosclerosis,' 'healed ulcers,' 'venous leg ulcer,' 'superficial venous thrombosis,' 'deep venous thrombosis,' 'post thrombotic syndrome,' 'compression post venous procedures,' 'lymphedema,' 'medical compression stockings,' 'inelastic bandages,' and 'adjustable compression wraps' were combined to obtain the pool of articles of interest. Inclusion criteria were papers published in peer-reviewed journals between January 1980 and October 2022; only papers in English were included.

Exclusion criteria included abstract conference and in vitro and ex vivo studies, and providing clinical and subjective outcomes. The reference list of selected studies was screened for further relevant publications. Studies on intermittent pneumatic compression were excluded (Fig).

RESULTS

CT in C0s to $C2_S$ We have studies proving the effectiveness of CT by medical compression stockings (MCSs) exerting 15 to 20 mm Hg in relieving symptoms such as aching, pain, leg cramps, heaviness, tenderness, and restlessness and in improving quality of life (QoL) in healthy people, in patients in C0s and in the early stages of CVD (C1s-C2s).[1-7] Nevertheless, a Cochrane review[8] raises doubts about the scientific appropriateness of many studies in patients with symptomatic varicose veins. The review includes 13 studies where MCSs were applied in

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1021 patients with varicose veins. The authors report (1) inconsistent selection of patients, (2) extreme variability in MCSs prescription, (3) different study protocols, and (4) risk of bias. In addition, comorbidities are often neglected, leading to uneven case series. In conclusion, despite the beneficial effect of MCS on symptoms due to varicose veins reported by all studies, many methodological flaws led the review authors to the following frustrating conclusions: "The certainty of the evidence was therefore low to very low" and "There is insufficient high-certainty evidence to determine whether or not compression stockings are effective as the sole and initial treatment of varicose veins …, or whether any type of stocking is superior to any other type." Finally, the authors recommend new high-quality studies.[8] This means that no substantial evidence supports the prescription of MCS in symptomatic patients in the initial stages of CVD and that new studies avoiding methodological flaws are necessary. Clinical guidelines provide us with a snapshot of these contrasting data. The American Guidelines[9] "suggest" MCS in symptomatic varicose veins with a low grade of recommendation and evidence (Level of Evidence II, Grade C). The European guidelines[10] recommend MCSs with strong grade and evidence (Level of Evidence, I, Grade B).

CT in C3 disease. Leg edema can occur in patients with venous insufficiency and in normal subjects standing or sitting all day for work reasons (the so-called occupational edema that disappears during landing and activity recovery). MSCs in the range of 10 to 20 mm Hg are effective in prevent long-haul flight[11-13] and occupational edema.[14-19] Compression by IBs, MCSs, and adjustable compression wraps with a compression pressure of 20 to 40 mm Hg are necessary to treat venous edema,[20-22] heart failure-related edema (with the exclusion of patients in class IV of New York Heart Association),[23,24] and in edema in diabetic patients.[25,26]

CT in C4 disease. We have some studies supporting the use of MCS in patients with lipodermatosclerosis.[27-32] A compression pressure of approximately 40 mm Hg is necessary to decrease sclerotic areas,[27,28] whereas a lower pressure of 18 to 36 mm Hg is enough to remove tissue fluid.[31] CT in C5 MSCs are effective in preventing ulcer recurrence. The higher the compression pressure, the better the prevention effect. Indeed, MCS exerting a compression pressure of 25 to 35 mm Hg had a more significant impact than MCS exerting 15 to 24 mm Hg.[33,34] Compliance must be considered and seems to exert an even more substantial role than compression pressure. In conclusion, the authors recommend prescribing MCS with the highest pressure tolerated by the patient.[35]

CT in C6 disease. CT is one of the cornerstones of venous leg ulcer (VLU) treatment, strongly recommended in the most recent guidelines and consensus papers.[9,10,36-38] It is quite surprising that a recent review is more cautious regarding the remarkable effectiveness of CT in VLU management.[39] The authors conclude that leg ulcers probably heal more quickly when treated by CT and that CT probably reduces pain and may improve QoL. In the authors' opinion, the main weak points of considered studies are risk of bias, small patient numbers, variability of ulcer sizes and durations, significant number of used compression devices, and very low-certainty evidence on the cost-effectiveness of compression. Aside from the very subjective "uncertainties" of these authors on CT effectiveness, CT remains a fundamental therapeutic procedure in VLU management.[9,10,36-38] We do not yet know the optimal treatment for VLU in terms of compression devices and exerted pressure. We have data that IBs are more effective than elastic bandages in improving impaired venous hemodynamics.[40-43] They should be more effective in increasing the healing rate of VLU owing to a hemodynamic impairment. In addition, it is well-known that the higher the pressure, the higher the healing rate,[44] which should favor inelastic material, exerting a much higher standing pressure than elastic material. Studies are reporting greater effectiveness with IBs over elastic material.[45-47] Nevertheless, some studies claim better effectiveness on the healing rate of MCSs[48,49] or elastic bandages[50] than inelastic materials. Two studies report similar effectiveness of elastic and inelastic compression on ulcer healing.[51,52] Finally, multicomponent bandages are reported as the best treatment modality in VLU by a previous Cochrane review "provided one layer is elastic."[53] The papers comparing elastic and inelastic materials have many methodological flaws, the two major being the lack of compression pressure and stiffness assessment and the lack of education in applying IBs.[54] Compression pressure is the dosage of compression. When not measured, it is impossible to know if the compression material was applied correctly and if it exerts the pressure required to promote ulcer healing. By using MCS, we approximately know their pressure as guaranteed by the manufacturers, even if the exerted pressure does not always correspond with the pressure declared by the manufacturer.[55] Quite the opposite, it is well-known that IBs are usually poorly applied.[56-60] In one study,[56] the authors showed that, even when given expert nurses routinely applied IBs in patients with ulcers, the same IB, exerting a pressure of 50 to 60 mm Hg when correctly wrapped, was applied with a pressure ranging from a few mm Hg to >140 mm Hg. These studies raise doubts about the conclusions of comparative papers not reporting compression pressure. In one of the very few studies where the authors measured the compression pressure, the IB was so poorly applied that its pressure was lower than that of an elastic kit used as a comparator.[61] The authors concluded that the elastic kit

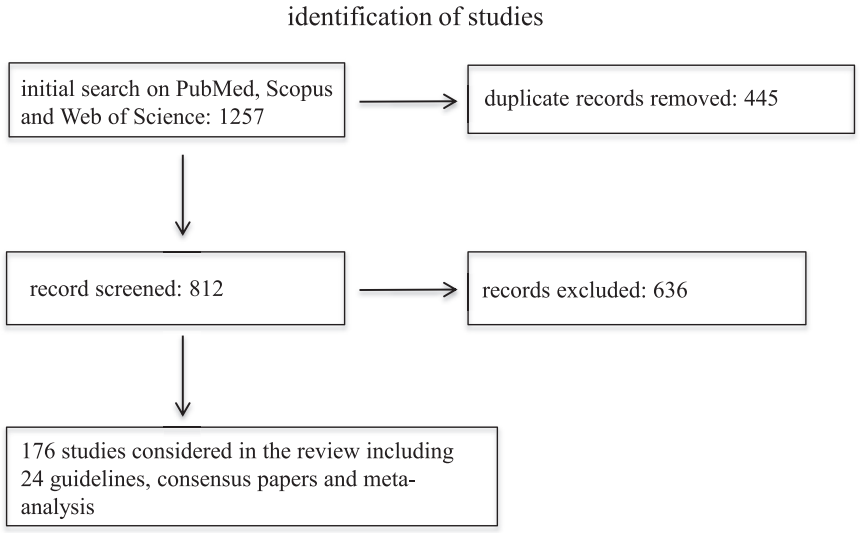

Fig. PRISMA flow diagram of relevant literature identified.

was more effective than the IB. It would be better to state that "an effective elastic kit was superior to a very poorly applied IB." Furthermore, without measuring compression pressure it is impossible to assess the stiffness of the applied compression, which led many authors to the dogmatic conclusion that the so-called four-layer bandage is elastic only because it is made up of four elastic bandages. When the four-layer bandage is applied, it becomes inelastic, possibly owing to the friction between different layers.[62] Comparing an IB with the four-layer, two IBs were compared, making the conclusion of these studies hard to accept. The conclusion of the Cochrane review,[53] based on these studies, is hard to get, too. However, hard to believe, we currently miss high-quality studies comparing elastic and inelastic material for ulcer healing and showing which is the best treatment option. The decision on what material to use is left to the individual preference of doctors or nurses.

CT to prevent venous disease progression. We lack data to recommend CT to prevent venous disease progression. There is only a tiny study[63] reporting the effectiveness of MCS in progression prevention, but this is not confirmed by other studies.[64]

CT after venous procedures. CT after venous procedures is one of the most debated issues in CT. The rationale for applying CT after venous procedures is minimizing or preventing side effects, such as pain, inflammation, bleeding, hematoma, bruising, and superficial or deep vein thrombosis (DVT) by compressing the treated vein (after endovenous procedures) or the removed vein track (after vein stripping or phlebectomies). Also, prevention of varicose veins recurrence after vein stripping was reported.[65] In this field we have many papers in favor of the beneficial effect of CT, by strong[66-70] or light[71-75] pressure and many other reporting that CT after venous procedures is useless.[76-80] In one systematic review, it was reported that the routine use of CT after thermal ablation of varicose veins was effective in decreasing postoperative pain and the time to return to normal activities.[74] Once again, the conclusion of this paper is opposite to the conclusion of another systematic review,[80] increasing the uncertainty as to whether CT is effective or not after thermal ablation of varicose veins. The only general agreement regarding vein stripping or phlebectomies where CT is generally recommended.[81-83] These conflicting data are reflected in one recent consensus paper[84] and in one guideline,[10] suggesting CT after vein procedures with very low evidence, although CT is strongly recommended in another consensus paper.[85] All these discrepancies could be caused by some methodological flaws in many of these papers. The sample size is often inadequate to get a statistically significant difference between different compression modalities or between compression and no compression. Compression pressure was rarely measured and, when measured, firm compression showed to reduce postoperative side effects more effectively than light compression in decreasing postoperative side effects.[66-70] Furthermore, compression pressure exerted by MCS at thigh level is hardly >10 mm Hg, much lower than the 40 mm Hg necessary to occlude the veins at the thigh level.[86] Many studies comparing MCS and no compression actually compared no compression and no compression, making the conclusions difficult to accept. Vein diameter is never mentioned, but it has been reported that the recanalization rate and side effects are much higher when treating large veins than small veins.[87-89] Finally, noncompliant patients are included in the final analysis,[76] when they should be excluded. The same contrasting data regard the optimal duration of

compression, with some papers reporting a short time of 3 days as enough to control side effects[81,90] and another reporting that a period of 1 to 2 weeks is more effective than a shorter time.[91] A >7 days does not increase the effectiveness in reducing the unwanted effects.[92] In conclusion, we can sadly state that we do not know if CT is helpful after venous procedures or what its optimal duration is.

CT in superficial vein thrombosis. Studies on CT as the sole treatment of superficial vein thrombosis (SVT) do not exist because CT is always associated with antithrombotic and anticoagulant therapy. One consensus document recommends CT as an effective treatment in addition to antithrombotic therapy.[93] Another study[94] reports that compression does not add any advantage to the antithrombotic treatment concerning the reduction of pain, consumption of analgesics, thrombus length, skin erythema, D-dimer, or QoL. However, MCS stimulated significantly faster thrombus regression after 7 days of wear. In the most recent guidelines on the management of venous thrombosis, CT is not even mentioned in the treatment of SVT.[95] In conclusion, we need to learn more about the effectiveness of CT in SVT treatment. When CT is prescribed, we do not have data on how long it must be used, although also this is a piece of vital information to get.

CT in thromboprophylaxis. The rationale of CT in bedridden patients to prevent DVT is compressing the veins,[96-98] increasing the venous blood velocity,[99] and so minimizing venous stasis. Whatever the involved mechanism, MCSs were very effective in DVT prevention in surgical patients as a unique treatment and combined with other therapeutical interventions.[100] Several papers confirmed the MCS effectiveness in this field,[101-103] and these positive reports were reflected in a Cochrane review.[104] MSCs were reported to be effective also in decreasing the incidence of asymptomatic DVT in addition to reducing leg edema and SVT in airline passengers.[105] Recent studies comparing MCS alone with pharmacological thromboprophylaxis plus MCS in surgical patients and in patients undergoing knee arthroscopy did not report any advantage of the additional MCS compared with pharmacological thromboprophylaxis alone.[106-108] As one of these studies[106] highlights, "further studies are required to evaluate whether or not adjuvant graduated compression stockings have a role in patients receiving extended thromboprophylaxis, beyond the period of hospital admission, following elective surgery or in patients undergoing emergency surgical procedures."

Furthermore, thigh-length MCSs are ineffective in preventing DVT in stroke patients,[109] even if this result is unclear. The same authors in the following paper conclude that thigh-length MCSs are more effective than knee-length MCS in DVT[110] prevention, making their first conclusion difficult to understand.[111] In no study concerning surgical and medical patients was the duration of immobility reported; however, this information should be known as well.

CT in DVT treatment. In the acute phase of DVT, CT counteracts the increased venous pressure in the leg and improves venous flow. In this way, CT can decrease edema and pain owing to the deep vein obstruction and its associated inflammatory response.[112,113] Compression immediately after DVT diagnosis was reported to prevent irreversible skin sign[114] and venous occlusion.[115] Flow restoration is essential to promote impaired thrombus resolution under low-flow conditions.[116] In clinical practice, initial compression is applied by multilayer IB or by MCS. When IBs represent the initial treatment, MCSs are prescribed when the edema has resolved. The importance of immediate compression for a favorable outcome of DVT, including improved QoL and a positive influence on recanalization, has been well-established.[112-120] Consequently, immediate CT after the diagnosis of DVT is broadly used worldwide[121] and strongly recommended in the recent guideline on venous thrombosis.[95] New studies are necessary to clarify the optimal compression device immediately after DVT diagnosis, the optimal compression pressure, and optimal length.

CT in the prevention of post-thrombotic syndrome. Another very debated topic regarding CT. Many data from past studies report the beneficial effects of compression in preventing post-thrombotic syndrome (PTS).[122-126] The guideline reflected the widespread belief in compression's effectiveness in preventing PTS with a strong recommendation.[127] Afterward, a new study comparing class III MCS and placebo stockings in patients with acute DVT proved that MCSs are ineffective in PTS prevention, because it occurred in about the same percentage of patients wearing MCS or placebo stockings.[128] Despite many methodological flaws,[15,129] this study raised many doubts about the actual effectiveness of MCS in preventing PTS and was followed by another study arriving at the same conclusion.[130] In addition, different meta-analyses reflects these contrasting data, with one favoring CT to prevent PTS[131] and one against it.[132] In new guidelines and meta-analyses, MCS are not longer recommended, but only suggested with low-quality evidence.[95,133] New studies on CT applied immediately after DVT diagnosis[115] and continued for ≥6 months[134] confirm the compression effectiveness in PTS prevention. In another study, MCSs effectively prevented PTS, even in patients with proximal DVT without thrombus removal.[135]

In a recent study in patients with proximal DVT, MCSs were reported as significantly effective in PTS prevention

in patients with residual venous obstruction. In patients without venous obstruction, the MCSs were slightly but not significantly more effective.[136] In conclusion, in this field, we miss reliable and consistent data owing to study cohort variability, which has created a wide range of study results.

CT in PTS treatment. PTS is characterized by symptoms and signs typical of CVD. Feelings of leg heaviness, tiredness, and pain increasing throughout the day, aggravated by standing or walking and improved by rest and leg elevation, are common. The typical signs are edema, redness, and eventually lipodermatosclerosis and ulcers in severe cases. Amazingly, CT improves all these symptoms and signs,[3-7] but it seems to be ineffective when the same symptoms and signs are caused by PTS. We have only three small studies on MCS in PTS treatment.[123,137,138] Two studies reported no benefit of compression over no compression.[123,137] The third study,[138] focused on the effects of MCSs on venous hemodynamics as assessed by air plethysmography, did not consider the symptoms and signs of PTS.

Lymphedema. CT is part of a more complex therapeutical strategy for lymphedema: complex decongestive therapy, including skin care, physical activity, manual lymphatic drainage, and CT.[139-144] It is not easy to find a publication on lymphedema therapy where CT is the sole treatment. Also, clear recommendations from guidelines are missing.[145] In this field, routine clinical treatment was established and reported in the consensus documents. In the initial phase, the so-called treatment stage, CT, by multilayer, multicomponent IBs, is applied together with the mentioned treatments.[139-144]

Adjustable compression wraps—special inelastic compression devices with Velcro closure—are an effective treatment alternative to IB.[146] As soon as edema has been removed, a particular type of MCS—flat-knitted compression stockings—is applied. These stockings are particularly indicated for the maintenance phase of lymphedema when it is necessary to maintain the result and prevent edema recurrence. In some studies, CT started with compression hosiery, skipping the initial phase with multicomponent IBs. When two treatment modalities, one beginning with MCS and the other with IBs followed by MCS, were compared, this second option proved more effective in reducing arm lymphedema.[147,148] Even if clear evidence as isolated treatment is missing, CT included in the complex decongestive therapy proved to be a very effective therapeutical modality in lymphedema. Its effectiveness does not need to be demonstrated further.

CT and sport. Compression during or after sport does not represent a clinical indication but, it is a very debated topic and deserves to be mentioned in this review. Compression by specifically designed elastic stockings has spread over the years in several sports activities.

Compression during or after sport is applied to increase the sport's performance and benefit recovery. Even in this field, the effectiveness of compression is very debated. Studies usually include a small sample size; there is a lack of homogeneity owing to the use of different stockings in different sports, the level of sports participants (if professionals or only passionate), when and how long the stockings were worn, and the variety of sports socks regarding exerted pressure and pressure profile (graduated or progressive). In addition, sports and industry lobbies may have influenced some publications with a high biases risk and conflicts of interest.[149] Regarding performance increase by compression, some studies report beneficial effects,[150,151] whereas others, without biases, raise many doubts.[152] Many studies report positive effects in recovery time[153,154] without influencing the next sports performance.[155] There are also sparse data on reduced exercise-associated hemostatic activation decreasing the DVT risk during prolonged exercise[156] and on reduced perceived fatigue.[157] In this field, future studies are mandatory to confirm whether compression effectively improves recovery after sport or enhances sports performance. The beneficial effects of compression in athletes with varicose veins should be addressed as well. No study considered athletes with varicose veins, but many athletes with varicose veins ask about their disease and sport!

Lack of education resulting in poor patient compliance. IBs are challenging to apply and require education. Some papers[52-56] report that many health care professionals cannot apply IB with proper pressure. The pressure can be too low and ineffective or too strong, resulting in painful and potentially dangerous compression. Even with MCS, prescription mistakes regarding size and compression pressure can be made.[158-162] The lack of education in CT application or prescription can be a reason for noncompliance because the patients can find no benefit from compression or find it painful and harmful. Compression wraps represent a new compression modality. A short education time for the patient can be enough to apply the device properly.[146] Even with these devices, special care for a proper prescription is necessary.[163]

DISCUSSION

This literature revision shows that arguments favoring CT are weak, vague, nonexistent, or contrasting in disease progression prevention,[63,64] C0s, early-stage CVD (C1s-C2s),[8,9] venous postprocedures,[65-80] superficial venous thrombosis,[93-95] thromboprophylaxis in surgical patients,[106-111] PTS prevention,[15,128-130,132] PTS treatment,[123,137,138] and during or after sports[149-157] (Table).

Table. Available data in favor of compression therapy (CT) use in different clinical indications

	Strong indications for use[a]	Weak indications for use[b]	No or contrasting indications for use[c]
C0s-C2s		√	
C3-C5	√		
C6	√		
C6 (elastic/inelastic material)			√
Prevention of CVD progression			√
CT after venous procedures			√
SVT			√
Thromboprophylaxis			√
DVT	√		
DVT (elastic/inelastic material)			√
PTS prevention			√
PTS treatment			√
Lymphedema	√		
Sport performance			√
Sport recovery			√

[a]CT is effective. Data coming from a full agreement of published studies.
[b]CT is effective. Data coming from low quality scientific studies according to Cochrane review.[10]
[c]CT is effective? No or contrasting data regarding CT effectiveness.

Only a few medical indications for CT are endorsed by evidence-based medicine: in the more advanced stages of CVD (C3-C5),[11-35] in VLUs,[38-47] after venous stripping,[81-83] in DVT treatment,[112-121] and in lymphedema treatment and prevention.[139-145] In VLU and DVT treatment, it is necessary to clarify whether inelastic compression is the most effective treatment modality or if MCSs can be enough. The lack of data leads to an uncommon situation. On one side are health care providers familiar with CT, who know its effectiveness and apply CT in several clinical scenarios of CVD, even when strong indications are missing.[164-173] On the other side is a vast group of people (nurses and doctors, national health systems, and insurance company personnel) not specifically interested and lacking knowledge about the merits of an effective CT, who are reluctant to apply CT, even in areas where it could benefit patients. The main problem with CT is the low scientific level of many reported studies.

The list of methodological flaws is impressively long: small, underpowered studies unable to demonstrate a significant difference between treatments, inconsistent selection of patients, lack of a control group, incorrect randomization, lack of double blindness, extreme variability in CT prescription, totally different study protocols, a lack of pressure measurement and stiffness assessment, making impossible to recognize the different effects of various compression modalities, extremely variable time of application, often not specified, and risk of bias. Finally, compliance is rarely considered and reported. When reported, compliance is frequently very low.[76,128] Amazingly, noncompliant patients are included in the statistical analyses and final results, making the conclusions completely unrealistic; these patients should be excluded, as in all other fields of medicine.

All these methodological flaws make it possible to arrive at different and sometimes opposite conclusions. A good example is represented by CT after venous procedures where, owing to opposing data coming from different studies, we still do not know if compression is effective in preventing unwanted effects or totally useless. As a consequence of these confusing data, it also happened that even different guidelines suggest with low level of evidence or strongly recommend CT for the same indication. For instance, CT in symptomatic varicose veins is suggested with a low level of evidence (2C) by American Venous Forum-Society for Vascular Surgery guidelines[9] and strongly recommended (1B) by European Society for Vascular Surgery guidelines.[10] The same is true for other indications, raising the question of what kind of decision it is possible to take, looking at guidelines, if they give us different indications and what guideline we must refer to in our clinical practice. This is why we are strongly convinced that new high-quality studies on CT are necessary. As general recommendations, these new studies should be appropriately powered to demonstrate a significant difference between treatments, the selection of patients and randomization must be correctly performed, a control group is mandatory, double blindness should be considered, and CT prescription and study protocols should be consistent. Noncompliant patients should be excluded from the results analyses. Specific recommendations should be

added for specific studies. Finally, compression pressure, the most important parameter, the dosage of CT, must be measured and stiffness assessed by stiffness indices to ensure a correct and consistent compression device application.

An effective system to increase the reliability of studies on CT, certainly able to significantly improve their scientific quality, would be the use of specific sensors. Sensors measuring pressure, position and mobility under compression devices could be helpful. They could provide us with information not only on pressure and stiffness but also on compliance of patients (if the sensor does not record data, the patient is not wearing the prescribed compression) and on their daily activity (sitting, standing, walking, and lying time) that can make a tremendous difference in terms of outcomes. In this way, using sensors could eliminate the major methodological flaws in the studies on CT. Last but not least, clinical and QoL scores must be reported.

CONCLUSIONS

Our review highlights that we lack consistent data on CT effects in many clinical conditions and that work is necessary to fill the gaps in this critical treatment modality. As long as we cannot offer physicians and nurses, health care providers, national health systems, and insurance companies reliable scientific data regarding CT efficacy in the different indications, CT will remain an obscure treatment modality, underestimated or overestimated without strong clinical indications, and neither correctly used nor reimbursed.

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Writing the article: GM
Critical revision of the article: GM, CW, AC
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DISCLOSURES

None.

REFERENCES

1. Beebe HG, Bergan JJ, Bergqvist D, et al. Classification and grading of chronic venous disease in the lower limbs: a consensus statement. *Vasc Surg*. 1996;30:5–11.
2. Lurie F, Passman M, Meisner M, et al. The 2020 update of the CEAP classification system and reporting standards. *J Vasc Surg Venous Lymphat Disord*. 2020;8:342–352.
3. Blattler W, Kreis N, Lun B, Winiger J, Amsler F. Leg symptoms of healthy people and their treatment with compression hosiery. *Phlebology*. 2008;23:214–221.
4. Benigni JP, Bihari I, Rabe E, et al. Venous symptoms in C0 and C1 patients: UIP consensus document. *Int Angiol*. 2013;32:261–265.
5. Benigni JP, Sadoun S, Allaert FA, Vin F. Efficacy of Class 1 elastic compression stockings in the early stages of chronic venous disease. *Int Angiol*. 2003;23:383–393.
6. Schul MW, Eaton T, Erdman B. Compression versus sclerotherapy for patients with isolated refluxing reticular veins and telangiectasia: a randomized trial comparing quality-of-life outcomes. *Phlebology*. 2011;26:148–156.
7. Kakkos SK, Timpilis M, Patrinos P, et al. Acute effects of graduated elastic compression stockings in patients with symptomatic varicose veins: a randomised double blind placebo controlled trial. *Eur J Vasc Endovasc Surg*. 2018;55:118–125.
8. Knight SL, Robertson L, Stewart M. Graduated compression stockings for the initial treatment of varicose veins in people without venous ulceration. *Cochrane Database Syst Rev*. 2021;7:CD008819.
9. Gloviczki P, Lawrence PF, Wasan SM, et al. The 2023 Society for Vascular surgery, American venous Forum, and American vein and lymphatic Society clinical practice guidelines for the management of varicose veins of the lower extremities. Part II. *J Vasc Surg Venous Lymphat Disord*. 2023;11:231–261.
10. De Maeseneer MG, Kakkos SK, Aherne T, et al. Editor's Choice - European Society for Vascular surgery (ESVS) 2022 clinical practice guidelines on the management of chronic venous disease of the lower limbs. *Eur J Vasc Endovasc Surg*. 2022;63:184–267.
11. Hagan MJ, Lambert SM. A randomised crossover study of low-ankle-pressure graduated-compression tights in reducing flight-induced ankle oedema. *Med J Aust*. 2008;188:81–84.
12. Olsen JHH, Öberg S, Rosenberg J. The effect of compression stocking on leg edema and discomfort during a 3-hour flight: a randomized controlled trial. *Eur J Intern Med*. 2019;62:54–57.
13. Gianesini S, Mosti G, Raffetto JD, et al. Case-control evaluation of the impact of below 20 mmHg elastic compression stockings on lower limb volume serial variations in standardized flights. *Phlebology*. 2020;35:199–206.
14. Amsler F, Blättler W. Compression therapy for occupational leg symptoms and chronic venous disorders - a meta-analysis of randomised controlled trials. *Eur J Vasc Endovasc Surg*. 2008;35:366–372.
15. Partsch H, Winiger J, Lun B. Compression stockings reduce occupational leg swelling. *Dermatol Surg*. 2004;30:737–743.
16. Mosti G, Partsch H. Occupational leg oedema is more reduced by antigraduated than by graduated stockings. *Eur J Vasc Endovasc Surg*. 2013;45:523–527.
17. Blazek C, Amsler F, Blaettler W, Keo HH, Baumgartner I, Willenberg T. Compression hosiery for occupational leg symptoms and leg volume: a randomized crossover trial in a cohort of hairdressers. *Phlebology*. 2013;28:239–247.
18. Hecko S, Lutze S, Arnold A, Haase H, Jünger M, Riebe H. Improvement of occupational leg edema and discomforts (RCT). *Clin Hemorheol Microcirc*. 2022;82:125–139.
19. Guedes PM, Saldanha NA, Matos PM, Carvalho FS, Veiga G, Norton P. Occupational leg edema-use of compression stockings. *Porto Biomed J*. 2020;5:e093.
20. Mosti G, Picerni P, Partsch H. Compression stockings with moderate pressure are able to reduce chronic leg oedema. *Phlebology*. 2012;27:289–296.
21. Mosti G, Partsch H. Bandages or double stockings for the initial therapy of venous oedema? A randomized, controlled pilot study. *Eur J Vasc Endovasc Surg*. 2013;46:142–148.
22. Mosti G, Cavezzi A, Partsch H, Urso S, Campana F. Adjustable Velcro® compression devices are more effective than inelastic bandages in reducing venous edema in the initial treatment phase: a randomized controlled trial. *Eur J Vasc Endovasc Surg*. 2015;50:368–374.
23. Urbanek T, Juśko M, Kuczmik WB. Compression therapy for leg oedema in patients with heart failure. *ESC Heart Fail*. 2020;7:2012–2020.
24. Rabe E, Partsch H, Morrison N, et al. Risks and contraindications of medical compression treatment - a critical reappraisal. An international consensus statement. *Phlebology*. 2020;35:447–460.
25. Wu SC, Crews RT, Najafi B, Slone-Rivera N, Minder JL, Andersen CA. Safety and efficacy of mild compression (18-25 mm Hg) therapy in patients with diabetes and lower extremity edema. *J Diabetes Sci Technol*. 2012;6:641–647.
26. Rother U, Grussler A, Griesbach C, Almasi-Sperling V, Lang W, Meyer A. Safety of medical compression stockings in patients with

diabetes mellitus or peripheral arterial disease. *BMJ Open Diabetes Res Care*. 2020;8:e001316.
27. Vandongen YK, Stacey MC. Graduated compression elastic stockings reduce lipodermatosclerosis and ulcer recurrence. *Phlebology*. 2000;15:33–37.
28. Suehiro K, Morikage N, Harada T, et al. Compression therapy using bandages Successfully manages acute or Subacute lipodermatosclerosis. *Ann Vasc Dis*. 2019;12:77–79.
29. Arendsen LP, Vig S, Thakar R, Sultan AH. Impact of copper compression stockings on venous insufficiency and lipodermatosclerosis: a randomised controlled trial. *Phlebology*. 2019;34:224–230.
30. Herouy Y. Lipodermatosclerosis and compression stockings. *J Am Acad Dermatol*. 2000;42:307–308.
31. Gniadecka M, Karlsmark T, Bertram A. Removal of dermal edema with class I and II compression stockings in patients with lipodermatosclerosis. *J Am Acad Dermatol*. 1998;39:966–970.
32. Gniadecka M. Dermal oedema in lipodermatosclerosis: distribution, effects of posture and compressive therapy evaluated by high-frequency ultrasonography. *Acta Derm Venereol*. 1995;75:120–124.
33. Nelson EA, Harper DR, Prescott RJ, Gibson B, Brown D, Ruckley CV. Prevention of recurrence of venous ulceration: randomized controlled trial of class 2 and class 3 elastic compression. *J Vasc Surg*. 2006;44:803–808.
34. Dahm KT, Myrhaug HT, Strømme H, Fure B, Brurberg KG. Effects of preventive use of compression stockings for elderly with chronic venous insufficiency and swollen legs: a systematic review and meta-analysis. *BMC Geriatr*. 2019;19:76.
35. Clarke-Moloney M, Keane N, O'Connor V, et al. Randomised controlled trial comparing European standard class 1 to class 2 compression stockings for ulcer recurrence and patient compliance. *Int Wound J*. 2014;11:404–408.
36. O'Donnell TF Jr, Passman MA, Marston WA, et al. Management of venous leg ulcers: clinical practice guidelines of the Society for Vascular Surgery ® and the American Venous Forum. *J Vasc Surg*. 2014;60(2 Suppl):1S–2S.
37. Mosti G, De Maeseneer M, Cavezzi A, et al. Society for Vascular surgery and American venous Forum guidelines on the management of venous leg ulcers: the point of view of the international union of phlebology. *Int Angiol*. 2015;34:202–218.
38. Franks PJ, Barker J, Collier M, et al. Management of patients with venous leg ulcers: Challenges and current best practice. *J Wound Care*. 2016;25(Suppl 6):S1–S67.
39. Shi C, Dumville JC, Cullum N, Connaughton E, Norman G. Compression bandages or stockings versus no compression for treating venous leg ulcers. *Cochrane Database Syst Rev*. 2021;7:CD013397.
40. Partsch H, Menzinger G, Mostbeck A. Inelastic leg compression is more effective to reduce deep venous refluxes than elastic bandages. *Dermatol Surg*. 1999;25:695–700.
41. Partsch B, Mayer W, Partsch H. Improvement of ambulatory venous hypertension by narrowing of the femoral vein in congenital absence of venous valves. *Phlebology*. 1992;7:101–104.
42. Mosti G, Mattaliano V, Partsch H. Inelastic compression increases venous ejection fraction more than elastic bandages in patients with superficial venous reflux. *Phlebology*. 2008;23:287–294.
43. Mosti G, Partsch H. Duplex scanning to evaluate the effect of compression on venous reflux. *Int Angiol*. 2010;29:416–420.
44. Milic DJ, Zivic SS, Bogdanovic DC, et al. The influence of different sub-bandage pressure values on venous leg ulcers healing when treated with compression therapy. *J Vasc Surg*. 2010;51:655–661.
45. Brizzio E, Amsler F, Lun B, Blättler W. Comparison of low-strength compression stockings with bandages for the treatment of recalcitrant venous ulcers. *J Vasc Surg*. 2010;51:410–416.
46. Moody M. Comparison of Rosidal K and SurePress in the treatment of venous leg ulcers. *Br J Nurs*. 1999;8:345–355.
47. Finlayson KJ, Courtney MD, Gibb MA, O'Brien JA, Parker CN, Edwards HE. The effectiveness of a four-layer compression bandage system in comparison with Class 3 compression hosiery on healing and quality of life in patients with venous leg ulcers: a randomised controlled trial. *Int Wound J*. 2014;11:21–27.
48. Amsler F, Willenberg T, Blättler W. In search of optimal compression therapy for venous leg ulcers: a meta-analysis of studies comparing diverse bandages with specifically designed stockings. *J Vasc Surg*. 2009;50:668–674.
49. Ashby RL, Gabe R, Ali S, et al. Clinical and cost-effectiveness of compression hosiery versus compression bandages in treatment of venous leg ulcers (Venous leg Ulcer Study IV, VenUS IV): a randomised controlled trial. *Lancet*. 2014;383:871–879.
50. Nelson EA, Iglesias CP, Cullum N, Torgerson DJ, VenUS I collaborators. Randomized clinical trial of four-layer and short-stretch compression bandages for venous leg ulcers (VenUS I). *Br J Surg*. 2004;9:1292–1299.
51. De Carvalho MR, Peixoto BU, Silveira IA, Oliveria BGRB. A meta-analysis to Compare four-layer to short-stretch compression bandaging for venous leg ulcer healing. *Ostomy Wound Manage*. 2018;64:30–37.
52. Scriven JM, Taylor LE, Wood AJ, Bell PR, Naylor AR, London NJ. A prospective randomised trial of four-layer versus short stretch compression bandages for the treatment of venous leg ulcers. *Ann R Coll Surg Engl*. 1998;80:215–220.
53. O'Meara S, Cullum N, Nelson EA, Dumville JC. Compression for venous leg ulcers. *Cochrane Database Syst Rev*. 2012;11:CD000265.
54. Mosti G. Elastic stockings versus inelastic bandages for ulcer healing: a fair comparison? *Phlebology*. 2012;27:1–4.
55. Lurie F, Kistner R. Variability of interface pressure produced by ready-to-wear compression stockings. *Phlebology*. 2014;29:105–108.
56. Protz K, Heyer K, Dörler M, Stücker M, Hampel-Kalthoff C, Augustin M. Compression therapy: scientific background and practical applications. *J Dtsch Dermatol Ges*. 2014;12:794–801.
57. Reynolds S. The impact of a bandage training programme. *J Wound Care*. 1999;8:55–60.
58. Nelson EA, Ruckley CV, Barbenel JC. Improvements in bandaging technique following training. *J Wound Care*. 1995;4:181–184.
59. Keller A, Müller ML, Calow T, Kern IK, Schumann H. Bandage pressure measurement and training: simple interventions to improve efficacy in compression bandaging. *Int Wound J*. 2009;6:324–330.
60. Zarchi K, Jemec GBE. Delivery of compression therapy for venous leg ulcers. *JAMA Dermatol*. 2014;150:730–736.
61. Partsch H, Horakova MA. Compression stockings in treatment of lower leg venous ulcer. *Wien Med Wochenschr*. 1994;144:242–249.
62. Mosti G, Mattaliano V, Partsch H. Influence of different materials in multicomponent bandages on pressure and stiffness of the final bandage. *Dermatol Surg*. 2008;34:631–639.
63. Kostas TI, Ioannou CV, Drygiannakis I, et al. Chronic venous disease progression and modification of predisposing factors. *J Vasc Surg*. 2010;51:900–907.
64. Palfreyman SJ, Michaels JA. A systematic review of compression hosiery for uncomplicated varicose veins. *Phlebology*. 2009;24(Suppl 1):13–33.
65. Travers JP, Makin GS. Reduction of varicose vein recurrence by use of postoperative compression stockings. *Phlebology*. 1994;9:104–109.
66. Travers JP, Rhodes JE, Hardy JG, Makin GS. Postoperative limb compression in reduction of haemorrhage after varicose vein surgery. *Ann R Coll Surg Engl*. 1993;75:119–122.
67. Mosti G, Mattaliano V, Arleo S, Partsch H. Thigh compression after great saphenous surgery is more effective with high pressure. *Int Angiol*. 2009;28:274–280.
68. Benigni JP, Allaert FA, Desoutter P, Cohen-Solal G, Stalnikiewicz X. The efficiency of pain control using a thigh pad under the elastic stocking in patients following venous stripping: results of a case-control study. *Perspect Vasc Surg Endovasc Ther*. 2011;23:238–243.
69. Cavezzi A, Mosti G, Colucci R, Quinzi V, Bastiani L, Urso SU. Compression with 23 mmHg or 35 mmHg stockings after saphenous catheter foam sclerotherapy and phlebectomy of varicose veins: a randomized controlled study. *Phlebology*. 2019;34:98–106.
70. Lugli M, Cogo A, Guerzoni S, et al. Effects of eccentric compression by a crossed-tape technique after endovenous laser ablation of the great saphenous vein: a randomized study. *Phlebology*. 2009;24:151–156.
71. Mariani F, Marone EM, Gasbarro V, et al. Multicenter randomized trial comparing compression with elastic stocking versus bandage after surgery for varicose veins. *J Vasc Surg*. 2011;53:115–122.
72. Reich-Schupke S, Feldhaus F, Altmeyer P, Mumme A, Stücker M. Efficacy and comfort of medical compression stockings with low

and moderate pressure six weeks after vein surgery. *Phlebology*. 2014;29:358–366.
73. Bootun R, Belramman A, Bolton-Saghdaoui L, Lane TRA, Riga C, Davies AH. Randomized controlled trial of compression after endovenous thermal ablation of varicose veins (COMETA trial). *Ann Surg*. 2021;273:232–239.
74. Ma F, Xu H, Zhang J, et al. Compression therapy following endovenous thermal ablation of varicose veins: a systematic review and meta-analysis. *Ann Vasc Surg*. 2022;80:302–312.
75. Kern P, Ramelet AA, Wütschert R, Hayoz D. Compression after sclerotherapy for telangiectasias and reticular leg veins: a randomized controlled study. *J Vasc Surg*. 2007;45:1212–1216.
76. Hamel-Desnos CM, Guias BJ, Desnos PR, Mesgard A. Foam sclerotherapy of the saphenous veins: randomised controlled trial with or without compression. *Eur J Vasc Endovasc Surg*. 2010;39:500–507.
77. Pittaluga P, Chastanet S. Value of postoperative compression after mini-invasive surgical treatment of varicose veins. *J Vasc Surg Venous Lymphat Disord*. 2013;1:385–391.
78. Onwudike M, Abbas K, Thompson P, McElvenny DM. Editor's Choice - role of compression after radiofrequency ablation of varicose veins: a randomised controlled trial. *Eur J Vasc Endovasc Surg*. 2020;60:108–117.
79. Pihlaja T, Romsi P, Ohtonen P, Jounila J, Pokela M. Post-procedural compression vs. no compression after radiofrequency ablation and concomitant foam sclerotherapy of varicose veins: a randomised controlled non-inferiority trial. *Eur J Vasc Endovasc Surg*. 2020;59:73–80.
80. Hu H, Wang J, Wu Z, Liu Y, Ma Y, Zhao J. No benefit of wearing compression stockings after endovenous thermal ablation of varicose veins: a systematic review and meta-analysis. *Eur J Vasc Endovasc Surg*. 2022;63:103–111.
81. Houtermans-Auckel JP, van Rossum E, Teijink JA, et al. To wear or not to wear compression stockings after varicose vein stripping: a randomised controlled trial. *Eur J Vasc Endovasc Surg*. 2009;38:387–391.
82. Krasznai AG, Sigterman TA, Houtermans-Auckel JP, et al. A randomised controlled trial comparing compression therapy after stripping for primary great saphenous vein incompetence. *Phlebology*. 2019;34:669–674.
83. Huang TW, Chen SL, Bai CH, Wu CH, Tam KW. The optimal duration of compression therapy following varicose vein surgery: a meta-analysis of randomized controlled trials. *Eur J Vasc Endovasc Surg*. 2013;45:397–402.
84. Lurie F, Lal BK, Antignani PL, et al. Compression therapy after invasive treatment of superficial veins of the lower extremities: clinical practice guidelines of the American venous Forum, Society for Vascular surgery, American College of phlebology, Society for Vascular medicine, and international union of phlebology. *J Vasc Surg Venous Lymphat Disord*. 2019;7:17–28.
85. Rabe E, Partsch H, Hafner J, et al. Indications for medical compression stockings in venous and lymphatic disorders: an evidence-based consensus statement. *Phlebology*. 2018;33:163–184.
86. Partsch B, Partsch H. Which pressure do we need to compress the great saphenous vein on the thigh? *Dermatol Surg*. 2008;34:1726–1728.
87. Kemaloğlu C. Saphenous vein diameter is a single risk factor for early recanalization after endothermal ablation of incompetent great saphenous vein. *Vascular*. 2019;27:537–541.
88. Aurshina A, Ascher E, Victory J, et al. Clinical correlation of success and acute thrombotic complications of lower extremity endovenous thermal ablation. *J Vasc Surg Venous Lymphat Disord*. 2018;6:25–30.
89. Lomazzi C, Bissacco D, Logan MS, et al. Risk factors for saphenous vein recanalization after endovenous radiofrequency ablation. *J Cardiovasc Surg*. 2021;62:427–434.
90. Al Shakarchi J, Wall M, Newman J, et al. The role of compression after endovenous ablation of varicose veins. *J Vasc Surg Venous Lymphat Disord*. 2018;6:546–550.
91. Chou JH, Chen SY, Chen YT, Hsieh CH, Huang TW, Tam KW. Optimal duration of compression stocking therapy following endovenous thermal ablation for great saphenous vein insufficiency: a meta-analysis. *Int J Surg*. 2019;65:113–119.
92. Biswas S, Clark A, Shields DA. Randomised clinical trial of the duration of compression therapy after varicose vein surgery. *Eur J Vasc Endovasc Surg*. 2007;33:631–637.
93. Kalodiki E, Stvrtinova V, Allegra C, et al. Superficial vein thrombosis: a consensus statement. *Int Angiol*. 2012;31:203–216.
94. Boehler K, Kittler H, Stolkovich S, Tzaneva S. Therapeutic effect of compression stockings versus no compression on isolated superficial vein thrombosis of the legs: a randomized clinical trial. *Eur J Vasc Endovasc Surg*. 2014;48:465–471.
95. Kakkos SK, Gohel M, Baekgaard N, et al. Editor's Choice - European Society for Vascular surgery (ESVS) 2021 clinical practice guidelines on the management of venous thrombosis. *Eur J Vasc Endovasc Surg*. 2021;61:9–82.
96. Coleridge Smith PD, Hasty JH, Scurr JH. Deep vein thrombosis: effect of graduated compression stockings on distension of the deep veins of the calf. *Br J Surg*. 1991;78:724–726.
97. Partsch H, Mosti G, Mosti F. Narrowing of leg veins under compression demonstrated by magnetic resonance imaging (MRI). *Int Angiol*. 2010;29:408–410.
98. Partsch B, Partsch H. Calf compression pressure required to achieve venous closure from supine to standing positions. *J Vasc Surg*. 2005;42:734–738.
99. Charles T, Mackintosh D, Healy B, Perrin K, Weatherall M, Beasley R. Merino wool graduated compression stocking increases lower limb venous blood flow: a randomized controlled trial. *Adv Ther*. 2011;28:227–237.
100. Tan B, Xiao C, Cheng M, et al. A systematic review and meta-analysis of elastic stockings for prevention of thrombosis after orthopedic surgery. *Ann Palliat Med*. 2021;10:10467–10474.
101. Allan A, Williams JT, Bolton JP, Le Quesne LP. The use of graduated compression stockings in the prevention of postoperative deep vein thrombosis. *Br J Surg*. 1983;70:172–174.
102. Jeffery PC, Nicolaides AN. Graduated compression stockings in the prevention of postoperative deep vein thrombosis. *Br J Surg*. 1990;77:380–383.
103. Borow M, Goldson HJ. Prevention of postoperative deep venous thrombosis and pulmonary emboli with combined modalities. *Am Surg*. 1983;49:599–605.
104. Sachdeva A, Dalton M, Lees T. Graduated compression stockings for prevention of deep vein thrombosis. *Cochrane Database Syst Rev*. 2018;11:CD001484.
105. Clarke MJ, Broderick C, Hopewell S, Juszczak E, Eisinga A. Compression stockings for preventing deep vein thrombosis in airline passengers. *Cochrane Database Syst Rev*. 2021;4:CD004002.
106. Milinis K, Shalhoub J, Coupland AP, Salciccioli JD, Thapar A, Davies AH. The effectiveness of graduated compression stockings for prevention of venous thromboembolism in orthopedic and abdominal surgery patients requiring extended pharmacologic thromboprophylaxis. *J Vasc Surg Venous Lymphat Disord*. 2018;6:766–777.
107. Shalhoub J, Lawton R, Hudson J, et al. Graduated compression stockings as adjuvant to pharmaco-thromboprophylaxis in elective surgical patients (GAPS study): randomised controlled trial. *BMJ*. 2020;369:m1309.
108. Camporese G, Bernardi E, Prandoni P, et al. Low-molecular-weight heparin versus compression stockings for thromboprophylaxis after knee arthroscopy: a randomized trial. *Ann Intern Med*. 2008;149:73–82.
109. Dennis M, Sandercock PA, Reid J, et al. Effectiveness of thigh-length graduated compression stockings to reduce the risk of deep vein thrombosis after stroke (CLOTS trial 1): a multicentre, randomised controlled trial. *Lancet*. 2009;373:1958–1965.
110. Dennis M, Cranswick G, Deary A, et al. Thigh-length versus below-knee stockings for deep venous thrombosis prophylaxis after stroke: a randomized trial. *Ann Intern Med*. 2010;153:553–562.
111. Kearon C, O'Donnell M. Should patients with stroke wear compression stockings to prevent venous thromboembolism? *Ann Intern Med*. 2010;153:610–611.
112. Partsch H, Blattler W. Compression and walking versus bed rest in the treatment of proximal deep venous thrombosis with low molecular weight heparin. *J Vasc Surg*. 2000;32:861–869.
113. Roumen-Klappe EM, den Heijer M, van Rossum J, et al. Multilayer compression bandaging in the acute phase of deep-vein thrombosis has no effect on the development of the post-thrombotic syndrome. *J Thromb Thrombolysis*. 2009;27:400–405.

114. Amin EE, Joore MA, Ten Cate H, et al. Clinical and economic impact of compression in the acute phase of deep vein thrombosis. *J Thromb Haemost*. 2018;16:1555–1563.
115. Amin EE, Bistervels IM, Meijer K, et al. Reduced incidence of vein occlusion and post-thrombotic syndrome after immediate compression for deep vein thrombosis. *Blood*. 2018;132:2298–2304.
116. Cooley BC, Chen CY, Hess R, Schmeling G. Incomplete resolution of deep vein thrombosis under reduced flow conditions. *Thromb Res*. 2013;131:55–58.
117. Partsch H. Compression therapy for deep vein thrombosis. *Vasa*. 2014;43:305–307.
118. Blättler W, Partsch H. Leg compression and ambulation is better than bed rest for the treatment of acute deep venous thrombosis. *Int Angiol*. 2003;22:393–400.
119. Arpaia G, Cimminiello C, Mastrogiacomo O, de Gaudenzi E. Efficacy of elastic compression stockings used early or after resolution of the edema on recanalization after deep venous thrombosis: the COM. PRE Trial. *Blood Coagul Fibrinolysis*. 2007;18:131–137.
120. Brandjes DP, Büller HR, Heijboer H, et al. Randomised trial of effect of compression stockings in patients with symptomatic proximal-vein thrombosis. *Lancet*. 1997;349:759–762.
121. Rabe D, Partsch H, Heidl G, et al. Compression treatment in acute symptomatic proximal deep venous thrombosis - results of a worldwide survey. *Phlebology*. 2021;36:526–534.
122. Prandoni P, Lensing AW, Prins MH, et al. Below-knee elastic compression stockings to prevent the post-thrombotic syndrome: a randomized, controlled trial. *Ann Intern Med*. 2004;141:249–256.
123. Ginsberg JS, Hirsh J, Julian J, et al. Prevention and treatment of postphlebitic syndrome: results of a 3-part study. *Arch Intern Med*. 2001;161:2105–2109.
124. Partsch H, Kaulich M, Mayer W. Immediate mobilisation in acute vein thrombosis reduces post-thrombotic syndrome. *Int Angiol*. 2004;23:206–212.
125. Aschwanden M, Jeanneret C, Koller MT, Thalhammer C, Bucher HC, Jaeger KA. Effect of prolonged treatment with compression stockings to prevent post-thrombotic sequelae: a randomized controlled trial. *J Vasc Surg*. 2008;47:1015–1021.
126. Musani MH, Matta F, Yaekoub AY, Liang J, Hull RD, Stein PD. Venous compression for prevention of postthrombotic syndrome: a meta-analysis. *Am J Med*. 2010;123:735–740.
127. Kearon C, Kahn SR, Agnelli G, Goldhaber S, Raskob GE, Comerota AJ. Antithrombotic therapy for venous thromboembolic disease: American College of chest physicians evidence-based clinical practice guidelines (8th Edition). *Chest*. 2008;133(6 Suppl):454S–545S.
128. Kahn SR, Shapiro S, Wells PS, et al. Compression stockings to prevent post-thrombotic syndrome: a randomised placebo-controlled trial. *Lancet*. 2014;383:880–888.
129. Labropoulos N, Gasparis AP, Caprini JA, Partsch H. Compression stockings to prevent post-thrombotic syndrome. *Lancet*. 2014;384:129–130.
130. Jayaraj A, Meissner M. Impact of graduated compression stockings on the prevention of post-thrombotic syndrome - results of a randomized controlled trial. *Phlebology*. 2015;30:541–548.
131. Burgstaller JM, Steurer J, Held U, Amann-Vesti B. Efficacy of compression stockings in preventing post-thrombotic syndrome in patients with deep venous thrombosis: a systematic review and metaanalysis. *Vasa*. 2016;45:141–147.
132. Subbiah R, Aggarwal V, Zhao H, Kolluri R, Chatterjee S, Bashir R. Effect of compression stockings on post thrombotic syndrome in patients with deep vein thrombosis: a meta-analysis of randomised controlled trials. *Lancet Haematol*. 2016;3:e293–e300.
133. Appelen D, van Loo E, Prins MH, Neumann MH, Kolbach DN. Compression therapy for prevention of post-thrombotic syndrome. *Cochrane Database Syst Rev*. 2017;9:CD004174.
134. Ten Cate-Hoek AJ, Amin EE, Bouman AC, et al. Individualised versus standard duration of elastic compression therapy for prevention of post-thrombotic syndrome (IDEAL DVT): a multicentre, randomised, single-blind, allocation-concealed, non-inferiority trial. *Lancet Haematol*. 2018;5:e25–e33.
135. Yang X, Zhang X, Yin M, Wang R, Lu X, Ye K. Elastic compression stockings to prevent post-thrombotic syndrome in proximal deep venous thrombosis patients without thrombus removal. *J Vasc Surg Venous Lymphat Disord*. 2022;10:293–299.
136. Prandoni P, Lensing AWA, Prins MH, et al. Elastic compression stockings for prevention of the post-thrombotic syndrome in patients with and without residual vein thrombosis and/or popliteal valve reflux. *Haematologica*. 2022;107:303–306.
137. Frulla M, Marchiori A, Sartor D, et al. Elastic stockings, hydroxyethylrutosides or both for the treatment of post-thrombotic syndrome. *Thromb Haemost*. 2005;93:183–185.
138. Lattimer CR, Azzam M, Kalodiki E, Makris GC, Geroulakos G. Compression stockings significantly improve hemodynamic performance in post-thrombotic syndrome irrespective of class or length. *J Vasc Surg*. 2013;58:158–165.
139. The diagnosis and treatment of peripheral lymphedema: 2020 consensus document of the international Society of Lymphology. *Lymphology*. 2020;53:3–19.
140. Lee BB, Andrade M, Antignani PL, et al. Diagnosis and treatment of primary lymphedema. Consensus document of the International Union of Phlebology (IUP)-2013. *Int Angiol*. 2013;32:541–574.
141. European Wound management association (EWMA). In: Caine S, ed. *Focus document: lymphoedema bandaging in practice*. Medical Education Partnerships, Ltd; 2005.
142. Hettrick H, Ehmann S, McKeown B, Bneder D, Bleblea J. Selecting appropriate compression for lymphedema patients: American Veins and Lymphatic Society position statement. *Phlebology*. 2023;38:115–118.
143. Best practice for the management of lymphoedema – 2nd edition: Compression Therapy: A position document on compression bandaging. International Lymphedema Framework; 2012 Accessed December 26, 2018. https://www.lympho.org/wp-content/uploads/2021/09/Compression-bandaging-final.pdf.
144. Lee BB, Rockson SG, Bergan J. *Lymphedema. A Concise Compendium of theory and practice*. Springer International Publishing AG; 2018:431–441.
145. O'Donnell TF Jr, Allison GM, Iafrati MD. A systematic review of guidelines for lymphedema and the need for contemporary intersocietal guidelines for the management of lymphedema. *J Vasc Surg Venous Lymphat Disord*. 2020;8:676–684.
146. Damstra RJ, Partsch H. Prospective, randomized, controlled trial comparing the effectiveness of adjustable compression Velcro wraps versus inelastic multicomponent compression bandages in the initial treatment of leg lymphedema. *J Vasc Surg Venous Lymphat Disord*. 2013;1:13–19.
147. Badger CM, Peacock JL, Mortimer PS. A randomized, controlled, parallel-group clinical trial comparing multilayer bandaging followed by hosiery versus hosiery alone in the treatment of patients with lymphedema of the limb. *Cancer*. 2000;88:2832–2837.
148. King M, Deveaux A, White H, Rayson D. Compression garments versus compression bandaging in decongestive lymphatic therapy for breast cancer-related lymphedema: a randomized controlled trial. *Support Care Cancer*. 2012;20:1031–1036.
149. Benigni JP, Uhl JF. Medical compression and sport. In: Mosti G, Partsch H, eds. *Compression Therapy*. Edizioni Minerva Medica; 2022:184–191.
150. Engel FA, Holmberg HC, Sperlich B. Is there evidence that runners can benefit from wearing compression Clothing? *Sports Med*. 2016;46:1939–1952.
151. Driller MW, Halson SL. The effects of wearing lower body compression garments during a cycling performance test. *Int J Sports Physiol Perform*. 2013;8:300–306.
152. Mac Rae BA, Cotter JD, Laing RM. Compression garments and exercise: garment considerations, physiology and performance. *Sports Med*. 2011;41:815–843.
153. Cullen ML, Casazza GA, Davis BA. Passive recovery Strategies after exercise: a narrative literature review of the current evidence. *Curr Sports Med Rep*. 2021;20:351–358.
154. Dupuy O, Douzi W, Theurot D, Bosquet L, Dugué B. An evidence-based approach for Choosing post-exercise recovery techniques to reduce markers of muscle damage, Soreness, fatigue, and inflammation: a systematic review with meta-analysis. *Front Physiol*. 2018;9:403.
155. Atkins R, Lam WK, Scanlan AT, Beaven CM, Driller M. Lower-body compression garments worn following exercise improves perceived

recovery but not subsequent performance in basketball athletes. *J Sports Sci*. 2020;38:961–969.
156. Zadow EK, Adams MJ, Wu SSX, et al. Compression socks and the effects on coagulation and fibrinolytic activation during marathon running. *Eur J Appl Physiol*. 2018;118:2171–2177.
157. Gianesini S, Tessari M, Menegatti E, et al. Comparison between the effects of 18- and 23-mmHg elastic stockings on leg volume and fatigue in golfers. *Int Angiol*. 2017;36:129–135.
158. Maylor ME. Accurate selection of compression and antiembolic hosiery. *Br J Nurs*. 2001;10:1172–1184.
159. Winslow EH, Brosz D. Graduated compression stockings in hospitalized postoperative patients. Correctness of usage and size. *Am J Nurs*. 2008;108:40–50.
160. Gong JM, Du JS, Han DM, Wang XY, Qi SL. Reasons for patient noncompliance with compression stockings as a treatment for varicose veins in the lower limbs: a qualitative study. *PLoS One*. 2020;15:e0231218.
161. Hague A, Pherwani A, Rajagopalan S. Role of compression therapy in pathophysiology of the venous system in lower limbs. *Surgeon*. 2017;15:40–46.
162. Hampton S. Compression hosiery: selection and use for older people in care. *Nurs Resid Care*. 2017;19:149.
163. Ehmann S, Bock K. Case report to demonstrate the need for selection criteria for optimal adjustable Velcro wrap prescription. *J Wound Care*. 2018;27:S10–S17.
164. Rabe E, Hertel S, Bock E, Hoffmann B, Jöckel KH, Pannier F. Therapy with compression stockings in Germany - results from the Bonn vein studies. *J Dtsch Dermatol Ges*. 2013;11:257–261.
165. Juré J, Vuylsteke ME. Management of chronic venous disease in general practice: a cross-sectional study of first line care in Belgium. *Int Angiol*. 2022;41:232–239.
166. Dunic I, Vlajinac H, Marinkovic J, Maksimovic M, Radak D. Management of chronic venous disease by general practitioners in Serbia: a cross-sectional study. *Postgrad Med*. 2014;126:134–140.
167. El-Sheikha J, Nandhra S, Carradice D, et al. Compression regimes after endovenous ablation for superficial venous insufficiency-A survey of members of the Vascular Society of Great Britain and Ireland. *Phlebology*. 2016;31:16–22.
168. Decousus H, Quere I, Presles E, et al. POST (Prospective Observational Superficial Thrombophlebitis) Study Group. Superficial vein thrombosis and venous thromboembolism: a large prospective epidemiological study. *Ann Intern Med*. 2010;152:218–224.
169. Karathanos C, Spanos K, Lachanas V, Athanasoulas A, Giannoukas AD. Patterns in the management of superficial vein thrombosis. *Phlebology*. 2017;32:207–213.
170. Bauersachs R, Gerlach HE, Heinken A, et al. Management and outcomes of patients with isolated superficial vein thrombosis under real life conditions (INSIGHTS-SVT). *Eur J Vasc Endovasc Surg*. 2021;62:241–249.
171. Azirar S, Appelen D, Prins MH, Neumann MH, de Feiter AN, Kolbach DN. Compression therapy for treating post-thrombotic syndrome. *Cochrane Database Syst Rev*. 2019;9:CD004177.
172. Franke TPC, Backs FJG, Huisstede MA. Lower extremity compression garments use by athletes: why, how often, and perceived benefit. *BMC Sports Sci Med Rehabil*. 2021;13:31.
173. Driller MW, Brophy-Williams N. The use of compression garments in elite Australian athletes: a survey. *J Athl Enhanc*. 2016;5:3. https://doi.org/10.4172/2324-8793.1000116.

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