MOH BULLETIN #32

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This study confirms the connection between stationary standing and an increase in lower leg volume and leg symptoms. However, symptoms and increasing volume were not clearly correlat-ed. Light compression stockings were effective in reducing symptoms, while higher pressure was superior in reducing volume increase.

The effects of short-term use of compression stockings on health related quality of life in patients with chronic venous insufficiency
Four week use of compression stockings improved daily activities and independence and reduced symptoms of depression in patients with symptomatic C2 and C3 disease.

A compression kit of a stocking and three superimposed leggings is easy to don and dose adjustable
This study demonstrated the ease of donning of the SLLL compression kit consisting of an understocking with degressive graduation and three super imposable leggings for both healthy volunteers and patients with CVI compared to a traditional strong stocking.

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Lattimer CR, Kalodiki E, Azzam M, Geroulakos G.

Haemodynamic performance of low strength below knee graduated elastic compression stockings in health, venous disease, and lymphedema

Eur J Vasc Endovasc Surg 2016;52:105-112

Aim
This study aimed to assess the haemodynamic performance of graduated elastic compression (GEC) stockings in patients with varicose veins, post-thrombotic syndrome or lymphedema and compare it with healthy volunteers, with and without stockings of two compression strengths.

Methods
This single centre, prospective study recruited patients from a vascular outpatient's department and healthy volunteers from colleagues or health workers. The healthy volunteers had no evidence of venous disease whilst patients were defined as follows:

- Varicose veins: presence of venous symptoms, varicose veins and saphenous reflux > 0.5 seconds on duplex
- Post-thrombotic syndrome: history of DVT > 6 months, venous symptoms and presence of obstruction, wall thickening and/or reflux on duplex
- Lymphedema: dermal thickening, positive Stemmer's sign and delayed tracer uptake on lymphoscintigraphy

The stockings used were below the knee Class 1 (18-21 mmHg) and Class 2 (23-32 mmHg). Stocking pressure was measured supine in two locations using an air-sensor transducer. Performance parameters were measured before and during GEC use, including standard air-plethysmography (APG) tests (working venous volume [wVV], venous filling index [VFI], venous drainage index [VDI], ejection fraction [EF]) and the occlusion plethysmography tests (incremental pressure causing the maximal increase in calf volume [IPMIV] and outflow fraction [OF]).

Results
Twelve subjects were recruited for each of the four groups; the healthy volunteers (control group) were younger and had smaller calf and ankle circumferences compared to

the patient groups. Both classes of stocking produced significant graduated compression in all groups.

The effects on APG parameters showed no significant differences between GEC stocking class. Patients with varicose veins benefited the most, with significant improvements in wVV, VFI, IPMIV and OF ($p < 0.05$). In contrast, patients with lymphedema experienced improvements only in IPMIV, while post-thrombotic syndrome patients had no significant improvements in any of the APG parameters. This may be a result of the greater heterogeneity seen in the disease pathology of the post-thrombotic syndrome patients at baseline.

Conclusions

This study suggests that the disease profile of each patient affects the efficacy of the compression stocking to a greater extent than the compression strength. Assessing response to GEC in vivo may help identify those patients who will benefit the most.

Comments from the Editors

Using air plethysmography, the authors found significant improvement of some parameters in patients with varicose veins when light compression stockings were applied. It is demonstrated that venous volume is reduced and venous reflux diminished. However, the ejection fraction of the calf pump which is the most important parameter characterizing hemodynamic improvement did not change. This may be due to a principle methodological problem caused by putting the plethysmographic transducer over the pumping chamber and by the chosen exercise (3 tip-toe movements) Another reason may be the low compression pressure of the tested stockings, which might have been insufficient to achieve improvement of the venous calf pump function. Patients with severe states of chronic venous insufficiency (post thrombotic syndrome) did not show any functional improvement.Previous work using foot-volumetry was able to demonstrate, that compression stockings exerting higher pressure led to a significant improvement of the expelled volume (1) and that severe stages of chronic venous insufficiency had the highest degree of benefit (2). The modern trend to prefer compression stockings in the lower pressure range seems to be rather motivated by easier donning and doffing and by better compliance than by the goal to reach an adequate functional performance.

(1) Partsch H. Do we need firm compression stockings exerting high pressure? Vasa.1984;13(1):52-7

(2) Stöberl C, Gabler S, Partsch H. [Indications-related use of stockings-measuring venous pump function]. Vasa. 1989;18(1):35-9

Blättler W, Thomae HJ, Amsler F.

Venous leg symptoms in healthy subjects assessed during prolonged standing

J Vasc Surg:Venous and Lym Dis 2016;4:455-62

Aim
This study was undertaken to examine any relationship between leg volume increase and symptoms triggered by a period of stationary standing and to investigate the effect of medical compression stockings (MCS).

Methods
In order to test the hypothesis that symptoms would appear in correlation with an increase in leg volume, and that both would be alleviated with the use of MCS, the authors recruited healthy volunteers without venous disease. The baseline questionnaire included the Psychic versus Somatic Venous Disease Questionnaire (PsySoVDQ). Eligible subjects lay on a bed with legs elevated 30 degrees for 3 minutes before moving to the platform. Leg volume was measured by the Bodytronic 600, where subjects stand on a platform with a handrail and are rotated to allow accurate modelling and measurement of the legs. Seven measurements were taken during a 10 minute standing phase. At the end of each period on the platform, subjects were asked 'Do you experience any leg symptom now?' Response was recorded using the Numeric Rating Scale (NRS), with 0 denoting no symptoms and 10 indicating very strong symptoms. A questionnaire regarding the nature of any symptoms was completed after the final test.
Initially all subjects were measured with bare legs. Those who experienced symptoms below 2 points on the NRS throughout the 10 minute standing period were excluded from the compression stocking experiments. The remaining subjects completed 5 further tests on different days, but at the same time of day as the initial measurement. One was performed again with bare legs, followed by 4 tests with MCS on both legs. The MCS were applied immediately prior to the 3-minute leg drainage. MCS used were appropriate for the size of the subject and two ankle pressures were assessed: French class 1, ankle pressure 10-15 mmHg and German class 2, ankle pressure 23-32 mmHg.

Results
Forty-six volunteers without venous disease completed the first measurement. Of these, 18 reported no or few symptoms (⩽ 2 NRS points) and were excluded from further tests. Twenty-four subjects completed all the tests.

Leg volume
During the initial bare leg measurement, leg volume increased in all 46 subjects. There was no difference in leg volume increase between those who experienced no or few symptoms and those who reported more (> 2 NRS points). However, subjects who were included in the stocking studies had higher BMI and scored significantly higher on the psychic and somatic components of the PsySoVDQ ($p < 0.05$).

In the 24 subjects who completed the study, leg volume increased in two phases. The first was the period between the first measurement and approximately two minutes later. The recorded increase in volume during this phase was equivalent to

22 mL. The second phase consisted of the final 8 minutes of the standing time, and a further increase of 22 mL was recorded, giving a total of 44 mL.

Symptoms
Symptoms increased during the standing period to a mean NRS score of 2.93. The most prominent symptom was tingling (NRS, 5.07), significantly greater than all other symptoms ($p < 0.001$). Feelings of pressure and tension were the second most important symptoms (NRS, 2.17), significantly greater than pain and muscle ache ($p < 0.01$).

No correlation was found between increase in leg volume and emergence of symptoms. However, when comparing baseline data, experiencing more symptoms was correlated with a higher score in the somatic component of the PsySoVDQ (Spearman rho, 0.34; $p < 0.05$).

Effect of stockings
The increase in leg volume was significantly reduced with both stockings compared to bare legs (a reduction of 12 mL and 20 mL with French class 1 and German class 2, respectively), but there was no significant difference between stockings. Both stockings also reduced the emergence of symptoms to the same extent. All symptoms were reduced except for muscle ache, particularly tingling ($p < 0.001$) and itching ($p < 0.01$).

Conclusions
This study confirms the connection between stationary standing and an increase in lower leg volume. However, symptoms and increasing volume were not clearly correlated, with symptoms continuing to emerge despite a reduced rate of volume increase. Light compression stockings were effective in reducing symptoms, with the results from this study suggesting that they work in ways other than reducing volume alone.

Comments from the Editors
In their study the authors could confirm earlier findings of leg volume increase during a standing test in healthy volunteers. The volume increase has two phases, a first fast phase (app. 2 minutes) due to intravascular pressure induced diameter increase of the vessels and a second slower phase due to filtration of intravascular fluid into the surrounding tissue. During prolonged standing also leg symptoms like feeling of tingling, pain or itching appear but only in a part of the population. Interestingly volume increase is not clearly correlated with the appearance of symptoms. The authors claim that the reason might be different mechanisms for volume increase and symptoms during standing. In a second phase the symptomatic participants wore French class 1 or German class 2 compression stockings during the test. Both stockings reduced the development of symptoms significantly with the same extent. Volume increase was also reduced by both stockings but by a higher extent with the higher pressure. In conclusion volume increase is following the higher intravascular pressure in all participants whereas the development of symptoms seam to have additional risk factors independent from leg swelling an can be improved even with low external pressure.

Özdemir ÖC, Sevim S, Duygu E, Tuğral A, Bakar Y.

The effects of short-term use of compression stockings on health related quality of life in patients with chronic venous insufficiency

J Phys Ther Sci 2016;28:1988–1992

Aim
This study aimed to assess the effect of short term use of compression stockings on symptoms and health-related quality of life (HRQoL) in patients with chronic venous insufficiency (CVI).

Methods
Patients visiting an outpatient clinic were enrolled if they had received no prior treatment for CVI or varicose vein surgery and were classified as C2 and C3 according to CEAP. Patients were excluded if they had deep vein thrombosis, congestive heart failure, malignancy, more advanced skin changes (e.g. lipodermatosclerosis skin ulcers or other dermatological disease with pruritus) or were receiving ongoing compression stocking therapy. Overall HRQoL was assessed using the Turkish version of the Nottingham Health Profile (NHP) questionnaire, while symptoms and disease-specific QoL was measured using VEINES-QoL/Sym. The Beck Depression Inventory (BDI) was used to indicate any symptoms of depression. Questionnaires were completed at baseline and after four weeks.

Class 2 below the knee stockings were prescribed, giving a compression of 23-32 mmHg. Patients were instructed on correct application of the stocking and asked to wear it from first awakening until they went to bed for a period of four weeks. They were also given daily exercises: ankle pumping and heel lifts, and a walk of 30-45 minutes. Regular application of moisturiser was also recommended. Stocking usage was checked regularly via telephone interview to encourage compliance. Patients who did not receive compression stockings were given the same exercises and skin care routine to follow.

Results
126 patients were enrolled in the study, 44 in the study group and 82 in the control group (defined as patients who refused compression stocking therapy). Of these, 117 completed the study, 42 in the study group and 75 from the controls.

Significant differences between groups was found for all parameters after 4 weeks of treatment; NHP, VEINES-QoL and Sym and BDI, ($p < 0.05$). The study group also had significant improvements in all measures at four weeks compared to baseline ($p < 0.05$). In contrast, the control group experienced significant worsening of symptoms and QoL as assessed by the questionnaires ($p < 0.05$).

Conclusions
Short term use of compression stockings improved daily activities and independence and reduced symptoms of depression in patients with CVI. However, 64% of patients enrolled in the study refused compression treatment. The authors suggest that if patients can be persuaded into short term use of stockings, the benefits will aid in promoting long-term use.

Comments of the Editors
In this prospective non-randomised study symptomatic C2 and C3 patients who where willing to wear class 2 compression stocking for 4 weeks where compared to those not willing to do so. After 4 weeks the stocking group had significantly improved in symptoms, mobility and the Beck Depression Inventory while the non-stocking group had worsened. A limitation of this study is that the participants where not randomized to one of the groups but appointed because of their willingness to wear compression stockings. Compliance for compression may also influence the adherence to other treatment advices and the overall outcome. Both groups where advised to perform daily exercises: ankle pumping and heel lifts, and a walk of 30-45 minutes. It is not documented if the compliance for these measures was also different in the two groups. However the study could demonstrate the positive effect on symptomatic patients who where willing to use compression stockings on a daily basis.

Luder C, Dziunycz P, Omid N, Radetzki A-L, Lang C, Hübner M, Hafner J.

A compression kit of a stocking and three superimposed leggings is easy to don and dose adjustable

Eur J Vasc Endovasc Surg 2016;51:434-440

Aim
In response to the low level of compliance seen with compression stockings, this study assessed a compression stocking system that aims to be easy to don and dose adjustable.

Methods
Twenty patients over 65 years of age with chronic venous insufficiency (CVI) class C4 or C5 attending a phlebology consultation were recruited. Those with peripheral arterial disease or polyneuropathy were excluded. Healthy volunteers were recruited from staff and students within the department.

The system tested (SLLL) consisted of an understocking with degressive graduation and three superimposable leggings. The understocking provided a pressure of 17 mmHg at level cB, while the first legging exerted a pressure of 15 mmHg and leggings 2 and 3 provided an extra 10 mmHg each, all also with a degressive graduation to reach 50-80% of their pressure at level cD, below the knee. The legs of all participants were measured and details sent to the manufacturer to create 40 individual SLLL systems.

A compression stocking exerting 40 mmHg at cB (S40) was used as a control.

The donning process was demonstrated to each subject and success was considered as a fully donned SLLL kit or S40. There were no time constraints or limits on number of attempts. Patients were also asked to compare the ease of donning of the two systems. Pressure was measured whilst sitting during rest and ankle movements.

Results
All subjects completed the study, numbering 20 patients and 20 healthy volunteers.

Donning success
All the healthy volunteers successfully donned the SLLL kit and 19 of 20 the S40. All the patients with CVI also successfully donned the SLLL, compared with 12 of 20 who managed the S40 ($p = 0.02$). All subjects considered the SLLL kit easier to don.

Pressure
No significant differences in pressure at level cB1 during rest were recorded between SLLL and S40 for either study group; 34.4 mmHg with the SLLL and 37.5 mmHg with the S40 ($p = 0.1$), and 34.3 mmHg with SLLL compared with 37.3 mmHg with S40 ($p = 0.1$) for healthy volunteers and CVI patients, respectively.

The dynamic stiffness index (DSI) was 16.1 mmHg (SLLL) compared with 17.9 mmHg for patients with CVI ($p = 0.79$).

Conclusions
This study demonstrated the ease of donning of the SLLL compression kit for both healthy volunteers and patients with CVI compared to a traditional strong stocking. It also showed that the SLLL exerts similar physical properties to the S40 as measured by pressure at rest and DSI. The authors state the need for further studies assessing compliance with the SLLL and its clinical efficacy.

Comments of the Editors
One of the most important factors restricting the compliance of wearing compression stockings is the difficulty of donning and doffing. In the presented study, which concentrates on this practically very relevant point, 8 from 20 patients (40%) with advanced stages of chronic venous insufficiency were unable to put on a 40-mmHg stocking. By using one light stocking (17 mmHg) and superimposing 3 additional sleeves (15 mmHg, +10+10 mmHg) an interface pressure coming close to 40 mmHg can be reached with the advantage of much easier donning which could be successfully performed by all tested persons. This concept of superposition allows also to adjust the pressure to the individual needs and feelings of the patient. In patients starting compression therapy it is sometimes advisable to begin cautiously and to increase pressure when the patent shows growing confidence.

The sleeves cover the leg between the region proximal to the ankle up to the proximal calf, leaving the heel free. (As we know this is the most important hindrance to pull over a stocking.) The authors concede that the pressure gradient required in the official regulations for stocking producers may thereby be lost and that future studies will be needed to confirm the efficacy of this new system, both concerning clinical performance and improvement of objective parameters like-the reduction of oedema and refluxes and an improvement of venous pumping function. However, the concept is an important step towards tailoring the compression pressure to the individual need of the patient, thereby increasing the compliance of wearing compression stockings.

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