# Compression Bulletin 29

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**Compression stockings in the management of fractures of the ankle. A randomized controlled trial**

This study compared the impact of compression via patient-specific ankle injury stockings (AIS) plus Aircast boot with Tubigrip plus Aircast boot on recovery following a fracture of the ankle. The result showed that early application of compression via AIS following a fracture of the ankle reduced swelling and improved functional outcome with no significant complications.

**Randomised controlled trial comparing European standard class 1 to class 2 compression stockings for ulcer recurrence and patient compliance**

The study was designed as pilot study that compared the efficacy of European class 1 and class 2 compression stockings in preventing ulcer recurrence. Further aims were to identify patients who benefit from the greatest level of compression and to explore factors affecting compliance. The low sample size might have led to absence of significant differences between the treatment groups. Nevertheless, the study was still able to draw some important conclusions.

**Donning devices (foot slips and frames) enable elderly people with severe chronic venous insufficiency to put on compression stockings**

This study is the first to examine the ability of "real" elderly patients with chronic venous insufficiency to don compression stockings, and the first to demonstrate the benefits of donning devices. The results might contribute to improving the implementation of compression therapy carried out by patients.

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# Compression stockings in the management of fractures of the ankle. A randomised controlled trial

*Bone Joint J 2014;96B:1062-9*

**Aim**
The aim of this study was to compare the impact of compression via patient-specific ankle injury stockings (AIS) plus Aircast boot with Tubigrip plus Aircast boot on recovery following a fracture of the ankle.

**Methods**
Patients were identified in an accident and emergency clinic as having sustained a fracture of the ankle in the past 72 hours. Patients with previous fracture or ankle surgery, complex fracture or peripheral arterial disease were excluded. The uninjured leg was measured to select the correct size of AIS or Tubigrip. The pressure profiles chosen were 25 mmHg at the ankle, 17 mmHg at the mid-calf and 10 mmHg in the upper calf.

At two, four, eight and 12 weeks, and then later at six months, patients were assessed by a nurse blinded to treatment. The circumferences of the foot, calf and ankle were measured in both legs, with those of the injured leg calculated as a ratio of those in the uninjured one. The primary outcome was Olerud-Molander ankle score (OMAS) assessing function, with a score range 0 = totally impaired and 100 = completely unimpaired. The questionnaire was completed independently by the patient. Secondary outcomes were the American Orthopaedic Foot and Ankle Society score (AOFAS), Short-Form 12 version 2 quality of life assessment and the incidence of DVT at four weeks.

**Results**
Of the 90 patients randomised to treatment, 44 received AIS plus an Aircast boot and 46 received Tubigrip plus an Aircast boot. At four weeks the mean ratio of the ankle circumferences of the AIS treated patients had returned to normal at 1.00 (indicating no swelling) compared with a mean of 1.08 for the Tubigrip patients ($p < 0.001$). The reduced swelling was associated with an improved range of movement of the ankle in the AIS group, $p < 0.001$.

The primary endpoint, mean OMAS score, improved over time in both groups, but was significantly better at all time points for AIS treated patients, $p < 0.001$. At six months AIS patients achieved a mean OMAS score of 98 compared with a mean of 67 in the Tubigrip group, $p < 0.001$.

Patients treated with AIS also showed significantly better AOFAS scores at all time points compared with the Tubigrip patients, $p < 0.001$. Subcomponents of the AOFAS were also significant, including 97 % of AIS patients reporting no pain at six months compared with 33 % of Tubigrip patients, $p < 0.001$. The quality of life assessment showed the same pattern, with significantly greater improvements in the AIS than Tubigrip groups.

At four weeks 86 patients underwent duplex imaging; 15 (18 %) had a DVT, 5 in the AIS group and 10 in the Tubigrip group, $p = 0.26$. This study however, was not sufficiently powered to assess any impact of AIS on DVT frequency.

In the patients who had undergone surgery, the wound inspection score was lower (indicating greater healing) for the AIS patients than Tubigrip patients, $p = 0.009$.

**Conclusion**
This randomised controlled trial shows that early application of AIS following a fracture of the ankle reduces swelling and improves functional outcome with no significant complications. Larger studies are needed to determine whether AIS can reduce the frequency of DVTs in these patients.

**Comment of the Editors**
During the last years pneumatic orthotic boots have increasingly replaced plaster casts when the ankle is immobilized, both in stable fractures and after surgical fixation of unstable injuries. Swelling in connection with pain occurs immediately after trauma. Long-term outcomes are often poor, with > 70 % of patients reporting persistent pain, stiffness and swelling of the ankle- joint. Functional outcome and health-related quality of life scores are also subsequently impaired.
Preventing oedema by compression may reduce pain, improve range of movement and accelerate the return to normal function. Despite the swelling and risk of deep vein thrombosis (DVT), treatment with compression is still underused in these patients. The pressure of the inflated Aircast boots applied to the ankle is likely to be < 10 mmHg. This pressure may prevent further swelling but is obviously too low to reduce posttraumatic oedema. In patients with leg oedema due to chronic venous insufficiency it could be shown that compression stockings exerting a pressure of 24 mmHg are quite effective in reducing leg swelling (1). Actually the study presented by Sultan et al demonstrates that stockings exerting a pressure of 25 mmHg at the ankle are able to avoid swelling after fractures completely up to 26 weeks, in contrast to Tubigrip which had no influence on oedema. (The so-called patient-specific ankle injury stockings (AIS) correspond to well fitted, European class II compression stockings.)
In addition the range of movement of the ankle, pain level, quality of life and the functional parameters were also significantly improved in the stocking group. It is conceivable that the reported reduction of thrombotic complications in the stocking group is not only due to the improved mobility but also due to the anti-inflammatory action of compression on the traumatized tissue.
This study shows that compression therapy is a very effective treatment modality to reduce painful leg swelling, even in patients with bone fractures. Unfortunately the beneficial effects of compression in all sorts of painful tissue swelling are not fully appreciated in different other fields of medicine up to now. Examples are not only posttraumatic and postsurgical situations but also thrombotic and inflammatory diseases. Future studies will be needed to establish valid indications for compression in those areas by endorsing experience based management by scientific evidence.

**Literature**
1) 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 Jul;46(1):142-8).

Clarke-Moloney M, Keane N, O'Connor V, Ryan MA, Meagher H, Grace PA, Kavanagh E, Walsh SR and Burke PE

# Randomised controlled trial comparing European standard class 1 to class 2 compression stockings for ulcer recurrence and patient compliance

*Int Wound J 2014;11:404-8*

**Aim**
This pilot study was designed to compare the efficacy of European class 1 and class 2 compression stockings in preventing ulcer recurrence, to identify patients who benefit from the greatest level of compression whilst also exploring factors affecting compliance.

**Methods**
100 patients with healed venous leg ulcers were randomised to receive either class 1 (18-21 mmHg) or class 2 (23-32 mmHg) compression stockings. The primary endpoint, ulcer recurrence, was defined as epithelial breakdown anywhere below the knee of the study leg lasting more than four weeks and requiring compression bandaging treatment. Patients were followed up at 1 week, 3, 6, 9 and 12 months to monitor for ulcer recurrence and completed a questionnaire on compliance and their experience of wearing the stockings.

**Results**
50 patients were randomised to each treatment group, with a mean age of 69.3 years. Half of all patients had a history of multiple previous venous ulcers. The total ulcer recurrence rate at 12 months was 16.1%, with no significant difference between groups. Patients with a history of multiple ulcerations were more likely to develop a new ulcer, regardless of treatment group, $p = 0.001$. Of the patients diagnosed with superficial and deep incompetence only those in class 1 stockings had ulcer recurrence, identifying this subgroup as needing a higher level of compression.

Compliance was similar between groups, with a total of 11 patients not adhering to their prescribed treatment. When recurrence rates in these non-compliant patients were compared to that in the compliant group the difference in risk of developing a new ulcer was highly significant, $p < 0.0001$. In the patients who reported wearing their stockings, compliance with 'all day, every day' was 75% at 3 months and 65% at 12 months. The visual analogue scale of patient experience was 7.47 at 3 months and 7.30 at 12 months where 1 is a poor experience and 10 is excellent. Again, no significant difference between groups was found.

**Conclusion**
The absence of significant differences between treatment groups may have been due to insufficient sample size, however, the study was still able to draw some important conclusions. The relatively low rate of recurrence compared to other studies suggests that regular follow-up may improve compliance. As a greater number of new ulcers were reported in the class 1 group, the study also supports the idea that patients should be prescribed the highest level of compression they can tolerate, with those with both superficial and deep incompetence requiring the greatest level of compression.

**Comment of the Editors**
Based on the fact that good compliance is mandatory for effectivity of compression treatment and the widespread opinion that lower compression pressure improves compliance, this paper shows some interesting results:

1. Venous ulcer recurrence rate is significantly lower in patients compliant for the use of compression stockings.
2. Overall compliance with either class 1 (18-21 mmHg) or class 2 (23-32 mmHg) compression stockings is very good (89%) in patients who have experienced a venous leg ulcer and are now wearing compression

stockings to prevent recurrence. This means that higher compression does not discourage these patients to wear the stockings. In the Cochrane Review "Compression for preventing recurrence of venous ulcers" by EA Nelson, there was evidence for prevention of ulcer recurrence by compression stockings but no conclusion on compression class, length or type[1].

3. In both groups of patients who reported wearing their stockings, compliance with 'all day, every day' was 75 % at 3 months and 65 % at 12 months. This means that in compliant patiens there is a majority that uses compression every day and for the whole day. This is in accordance with the results of the Bonn Vein Study[2]. However the compliance drops with time after healing of the initial ulcer and the patients may need reencourage from time to time.
4. The visual analogue scale of patient experience was 7.47 at 3 months and 7.30 at 12 months where 1 is a poor experience and 10 is excellent. In consequence patients with healed ulcers tolerated compression stockings in both classes very well. This is also in line with the results of the Bonn Vein Study 2[2].
5. In patients diagnosed with a combination of superficial and deep incompetence only those in class 1 stockings had ulcer recurrence. This suggests that patients with a more advanced venous disease might definitely benefit from a higher compression class.

In conclusion patients with a healed venous ulcer should continue compression treatment with the highest compression class which is well tolerated. Compliance is good but motivation needs refreshment with time after healing.

**Literature:**

1) Nelson EA, Bell-Syer SE: Compression for preventing recurrence of venous ulcers. Cochrane Database Syst Rev. 2014 Sep 9;9:CD002303. doi: 10.1002/14651858.CD002303.pub3.

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Sippel K, Seifert B, Hafner J

# Donning devices (foot slips and frames) enable elderly people with severe chronic venous insufficiency to put on compression stockings

*Eur J Vasc Endovasc Surg 2015;49:221-9*

**Aim**
This study set out to assess whether donning devices could make it easier for patients >65 years with chronic venous insufficiency to successfully apply compression stockings of different strengths.

**Methods**
In this prospective comparative study 40 patients aged >65 years with severe chronic venous insufficiency were recruited at hospital. Patients with visual impairment, all types of paresis or plegia and developing dementia were excluded. One 40 mmHg stocking, open- and closed-toe (CS40-o-t and CS40-c-t) and two superimposed 20 mmHg stockings, open- and closed-toe (CS20+20-o-t and CS20+20-c-t) were used. The donning devices tested were three foot slips for open toe stockings and two foot slips and three frames for closed toe.

After instruction and demonstration patients had one attempt at putting on a CS40-c-t stocking and the superimposed stockings, CS20+20-c-t without using a device. Next the eight devices were tested in a random order; CS40-c-t (five devices, five attempts), CS40-o-t (three devices, three attempts), CS20+20-c-t (five devices, five attempts) and CS20+20-o-t (three devices, three attempts). Primary endpoint was a successful application defined as complete and correctly positioned donning of the stocking. The time taken was not included. Secondary endpoint was a subjective scoring of the attempt by the patient, where 1 is worst and 6 is very good.

**Results**
Forty patients were enrolled in the study, with a mean age of 78.7 years and 57.5 % female. A total of 720 donning attempts were made. Without a device, 60 % of patients were successful with the CS40-c-t stocking, and 70 % were able to put on the combined CS20+20-c-t stockings. When donning devices were used the number of patients who could successfully apply either a CS40 (open- or closed-toe) or CS20+20 (open- or closed-toe) increased to 93 % ($p = 0.008$).

Specifically the Easy Slide and Foot Slip devices allowed patients to don the CS40-o-t stocking significantly more often than without a device ($p = 0.001$ and $p = 0.002$, respectively). The Easy Slide Caran foot slip and Butler frame made significant differences to patients donning the CS40-c-t stocking, both $p = 0.002$.

Similar results were seen with the CS20+20 stockings, with the Easy Slide, Foot Slip, Easy Slide Caran and Butler devices showing a trend towards greater success for patients, however the differences were not significant. It is worth noting that the success of some devices was lower than that of no device as they were not suitable for every foot shape.

Patient characteristics associated with success rates without any device were ability to reach the forefoot with the hands ($p = 0.001$) and hand grip strength ($p = 0.003$). When using devices, only forefoot reach with the hands influenced success, $p = 0.001$.

Using the subjective evaluation, donning stockings with the aid of devices was generally graded better than without a device.

**Conclusion**
Compression therapy is effective in the improvement of symptoms of chronic venous insufficiency however, approximately 40 % of patients do not comply with treatment. This study showed that the use of two 'light' stockings (CS20+20) did not significantly improve success

compared with the use of one 'strong' stocking (CS40), but that the use of donning devices could significantly increase the successful application of either stocking from 73 % to 93 %.

**Comment of the Editors**
In this first study with a systematic examination of the ability of elderly patients with severe chronic venous insufficiency (CVI) to don compression stockings the authors could demonstrate many of these patients are not able to don their stockings without help.

The mean age was 78.7 years. Clinical CEAP class was C4 in 67.5 %, C5 in 20 % and C6 in 12.5 %. The donning of a "strong" compression stocking (34-46 mmHg) and a "light" compression stocking (18-21 mmHg) each provided with a closed and an open toe was compared. 60 % of the patients were able to don the "strong" compression stocking without donning device, 70 % the "light" compression stocking. In consequence 30 % of elderly patients are not even able to don a light compression stocking without help.

The precondition of treatment and compliance with compression stockings is the ability of the patients to don the stockings. If this is not the case, home care institutions can visit the patients at home and help them to put the stockings on. As this is a costly procedure several attempts have been made to develop donning devices which may help the patient for this purpose.

In the second part of the study the patients repeated the procedure with different donning devices. The authors demonstrated that the success rate was significantly different depending on the different donning devices used. However with simple devices like the "easy slide" the donning ability could be increased up to 93 %.

In consequence in elderly CVI patients who are in need for compression treatment it seems to be mandatory in 30 to 40 % to prescribe donning devices in addition to compression stockings. Currently this is only done in very rare cases. If not prescribed the patients do either need home care or they will not use the indicated compression treatment. However the donning problem is not limited to the elderly but does also appear in younger patients with orthopedic diseases or obesity.

If we prescribe compression we should always keep the "donning abilities" of the patient in mind.