Adopting compression strapping technique to enhance compression therapy in hard-to-heal leg ulcers

KEY WORDS
- Compression
- Leg ulcer
- Strapping

Leg ulcers represent a significant cost to the NHS with the majority of care being provided in the community (Guest et al, 2015). Individuals living with leg ulcers experience physical, social, psychological and financial costs (Platsidaki et al, 2017). Despite the use of graduated, multi-layered high compression therapy, which is recognised as gold standard treatment (NICE, 2017), some individuals experience a protracted healing time. It has been estimated that the cost of managing an unhealed wound is 4.5 times more than the cost of managing a healed wound (Guest et al, 2015). It has been suggested that the application of a novel, compression strapping technique can enhance compression therapy and promote healing (Hopkins et al, 2013). This case series evaluates the clinical outcomes of three patients with hard-to-heal retromalleolar ulcers using a novel compression strapping technique and evaluates the acceptability of the technique to patients and clinical staff.

SAMANTHA HAYNES
Tissue Viability Sister, Solent NHS Trust, Southampton

TERESA HALL
Tissue Viability Sister, Solent NHS Trust, Southampton

MONIQUE ROSELL
Clinical Lead, Tissue Viability Team, Solent NHS Trust, Southampton

A leg ulcer is defined as the loss of skin below the knee on the leg or the foot, which takes more than two weeks to heal (National Institute for Health and Care Excellence [NICE], 2013). Leg ulcers are the most common wound type in the community in the UK (Guest et al, 2015) and although the precise prevalence of leg ulceration is unclear, current estimates suggest prevalence rates to be 0.45/1000 in men and 0.56/1000 in women, increasing to 8.29/1000 in men and 8.06/1000 in women aged over 85 years old (Moffatt et al, 2004; Gethin et al, 2015; Guest et al, 2015). Venous leg ulcers (VLU) are the most common type of leg ulceration, with previous estimates suggesting that 1 in 170 adults had a VLU in the UK in 2012/13 (Guest et al, 2015). The estimated annual costs for managing these individuals were between £596.6 and £921.9 million in 2012/13 (Guest et al, 2017).

In addition to the costs to healthcare providers, it is also recognised that the experience of living with leg ulceration has significant physical, social, psychological and financial costs to the individual (Persoon et al, 2004). For example, a number of authors have identified that people with leg ulcers experience pain, exudate, odour, limitations to their mobility, sleep disturbance, social isolation, difficulties working, anxiety, depression and reduced quality of life (QoL) (Persoon et al, 2004; Green et al, 2013; Platsidaki et al, 2017). Leg ulcers can persist for months and even years and the unpredictability of healing can be disheartening for those living with leg ulcers, leading to feelings of powerlessness, frustration, guilt, disappointment and worry (Chase et al, 1997; Hopkins, 2004; Fearns et al, 2017).

VENOUS DISEASE

Venous disease occurs as a result of chronic venous insufficiency (CVI) and associated venous hypertension (Harding et al, 2015). CVI is related to venous reflux, or venous obstruction or a combination of both these mechanisms (Santler and Goerge, 2017). These mechanisms can be exacerbated by calf muscle pump dysfunction, due to immobility or abnormal gait, which causes reduced compression force required to overcome gravity and stimulate venous flow (Wounds International, 2013).

Venous reflux is associated with disrupted venous valve function, inflammation of vessel walls and haemodynamic factors as well as venous hypertension (Santler and Goerge, 2017). These mechanisms allow blood to 'reflux' or flow back towards the capillaries (Wounds International, 2013). The resulting high pressure causes dilation and elongation of capillary beds, thickening of basement membranes with increased collagen fibres, endothelial damage with widening interendothelial spaces and release of vasoactive agents and chemokines (Eberhardt and Raffetto, 2014; Santler and Goerge, 2017). Consequently, blood products leak into the surrounding tissues, leading to inflammation and increasing the risk of ulceration (Weller et al. 2018).

Venous obstruction, due to thrombosis, limits the outflow of blood and creates high venous pressure when the calf muscle contracts (Eberhardt and Raffetto, 2014). Venous obstruction can lead to the redirection of venous return through superficial veins which become dilated and overloaded, resulting in valve incompetence and reflux (Mościcka et al, 2019). Obstruction can also be associated with postthrombotic syndrome, a frequent complication of deep vein thrombosis that manifests as mild to debilitating signs and symptoms of CVI (Rabinovich and Kahn, 2017).

The exact pathogenesis and progression of venous insufficiency to ulceration is poorly understood (O'Meara et al, 2012). Several theories have been proposed such as the Fibrin Cuff Theory (Browse and Burnand, 1982), the White Cell Trapping Theory (Coleridge Smith et al, 1988) and the Trap Growth Theory (Higley et al, 1995). More recently, evidence has suggested that the expression of matrix metalloproteinase (MMP) and cytokines have a significant effect on vein walls, venous valves, the endothelium and destruction of the surrounding tissues (Raffetto and Khalil, 2008). A complex interplay involving venous hypertension, inflammation, changes in the microcirculation, activation of MMP and cytokines result in altered cellular function and VLU development (Raffetto, 2013).

THE ROLE OF COMPRESSION THERAPY

Compression therapy is widely accepted as the treatment of choice and gold standard therapy for the prevention and management of VLU (O'Meara et al, 2012; Harding et al, 2015; Wounds UK, 2016; NICE, 2017). Many patients present with a number of contributory comorbidities, so lower limb ulceration is often multi-factorial. Individuals with mixed aetiology and other aetiologies — such as sickle cell disease, rheumatoid arthritis or diabetes, and with ABPIs between 0.5 and 0.8 — can benefit from the use of modified compression under the care of a specialist team (Harding et al, 2015, Wounds UK, 2016).

Compression therapy has several beneficial effects that promote leg ulcer healing, for example, studies have demonstrated that compression therapy can reduce venous reflux, improve calf muscle pump function and reduce ambulatory venous hypertension (O'Donnell et al, 1979; Zajkowski et al, 2002; Ibegbuna et al, 2003). Compression primarily aids venous return by applying pressure to the leg, which decreases vein diameter, improves valve function, increases flow velocity and reduces venous reflux (Wounds International, 2009; Ashby et al, 2014; Partsch and Mortimer, 2015). It is well established that compression reduces oedema and improves lymphatic drainage, enhancing blood flow in the microcirculation (Amsler and Blättler, 2008; Mosti et al, 2012; Mosti and Partsch, 2013; Mosti et al, 2015). Studies have also found that compression therapy can reduce the pro-inflammatory environment characterised by leg ulceration; reducing elevated pro-inflammatory cytokine levels and increasing levels of the anti-inflammatory cytokine IL-1 Ra (Beidler et al, 2008; Beidler et al, 2009).

Randomised-controlled trials (RCTs) and meta-analysis have demonstrated the efficacy of compression therapy for managing VLU (O'Meara et al, 2012; Mauck et al, 2014). More recently, a RCT by Gohel et al (2018) concluded that early endovenous ablation of superficial venous reflux as an adjunct to compression therapy was associated with significantly shorter healing time compared to compression therapy alone.

Whilst the evidence that compression increases the healing rates of VLU is consistent and convincing, the optimal level of compression pressure is unclear and varies internationally (World Union of Wound Healing Societies [WUWHS],

Figure 1. The strapping technique uses additional narrow strips of cohesive short stretch compression bandage, layered in a fan distribution overlying the compression bandaging at the retromalleolal area

2008; Lurie et al, 2018). The WUWHS suggests that uncomplicated VLU should be managed with strong compression (≥40–60mmHg) (Wounds International, 2008). In the UK, NICE (2017) recommends that the most effective level of compression to overcome venous hypertension is 40 mmHg at the ankle and this should be achieved with the use of graduated, multi-layered high compression bandaging. However, it has been argued that standard graduated, high compression does not provide therapeutic compression in areas of the leg with concave rather than convex shape such as behind the retromalleolus (Hopkins et al, 2013; Mosti, 2013). Yet, this is an area where ulceration frequently occurs (Mosti, 2013).

In response to this, Hopkins et al (2011) reported a novel compression bandaging technique designed to enhance hard-to-heal leg ulcers in the retromalleolar area. The strapping technique uses additional narrow strips of cohesive short stretch compression bandage, layered in a fan distribution overlying the compression bandaging at the retromalleolal area *(Figure 1)*. To assess the effectiveness of this technique, Hopkins et al (2011) carried out a retrospective audit of 17 patients with mainly VLU but also mixed, sickle cell and rheumatoid arthritis aetiologies. The authors found that 23 out of the 25 ulcers healed, the treatment was well tolerated by patients and continuity of care with community nurses was achieved with good communication and patient-directed care. Hopkins et al (2011) concluded that the strapping technique is successful as it works with the anatomy of the patient's leg and enhances compression over the site of the ulceration, localised oedema and fibrotic tissue.

Subsequently, Hopkins et al (2013) investigated the sub-bandage pressure delivered with the use of inelastic compression therapy in the retromalleolal fossa using a standard regime of 10 cm spiral and a non-standard regime using 8 cm in a figure of eight from the toes compared with the addition of compression strapping. Hopkins and colleagues measured sub-bandage pressures with a Picopress (Microlab Elettronica Sas, Italy) with probes at the calf and the retromalleolal fossa. The authors found that mean pressures at the calf using the cohesive inelastic regime were 42 mmHg at rest and 62 mmHg on standing but were only 5 mmHg at rest, standing and on dorsiflexion at the lateral and medial retromalleolal fossa. The pressures increased to 25–48 mmHg with the addition of strapping. Hopkins et al (2013) concluded that standard high compression does not provide therapeutic compression at the retromalleolal area. The authors suggested that the strapping technique had significant clinical implications, increasing compression to the retromalleolar area without multiple layers of bandaging. This enables tailored care for the patient and their limb by targeting non-healing ulceration below the ankle and improves tolerance of treatment. Recently, the strapping technique has been advocated as a potential management solution to the challenge posed by complex VLU in atypical locations (Wounds UK, 2019).

ADOPTION OF THE STRAPPING TECHNIQUE IN CLINICAL PRACTICE

The Solent Tissue Viability Team operates a nurse-led Leg Clinic for patients with complex leg ulceration of various aetiologies. All patients referred to the Leg Clinic receive a thorough, holistic assessment based on best practice guidance (Wounds UK, 2016). Patients are followed up in the Leg Clinic and care is shared with the referrer when healing progresses.

The Solent Tissue Viability Team recognised that several patients attending Leg Clinic were not progressing to full healing despite the use of graduated, multi-layered high compression bandaging. The work undertaken by Hopkins et al (2011) prompted the team to trial the compression strapping technique in the treatment of patients with complex leg ulcers.

CASE SERIES

The key objective of this case series was to evaluate the clinical outcomes of three patients with hard-to-heal retromalleolar ulcers using Hopkins et al (2011) compression strapping technique and evaluate the acceptability of the technique to patients and clinical staff. The technique was easily adopted by the team, following peer teaching to ensure consistency and continuity of treatment. Staff supported one another with the application of the strapping initially but quickly became confident.

CASE 1

Figure 2. Mr Y's right retromalleolar ulcer prior to commencement of compression strapping technique

Figure 3. Mr Y's ulcer healed 7 weeks later

Table 1. Mr Y wound measurements, quality of life and pain scores over the course of treatment with compression strapping technique

Date (dd/mm/yy)	Length (mm)	Width (mm)	Quality of life	Pain score
23/10/18	45	35	8/10	5/10
14/11/18	12	9		No pain
04/12/18	6	6		No pain
27/12/19	Healed		9/10	No pain

Table 2. Mrs Z wound measurements, quality of life and pain scores over the course of treatment with compression strapping technique

Date	Length (mm)	Width (mm)	Quality of life	Pain score
18/01/19	65	40	3/10	10/10
29/01/19	70	60		
08/02/19	70	45		
11/02/19	57	30		6/10
22/02/19	50	11		
01/03/19	22	9	10/10	4/10
22/03/19	Healed			No pain

Table 3. Mrs X wound measurements, quality of life and pain scores over the course of treatment with compression strapping technique

Date	Length (mm)	Width (mm)	Depth (mm)	Quality of life	Pain score
06/09/18	11	5	2		
20/09/18	11	5	2		
04/10/18			2	4/10	4/10
11/10/18	10	4	1		
18/10/18	10	4	<1		3/10
2/11/18	9	3	0	8/10	No pain
29/11/18	Healed				No pain

All three patients presented here attended the Leg Clinic for weekly review and treatment, where a Tissue, Infection, Moisture imbalance, Edge of wound, Surrounding skin (TIMES) wound assessment was completed (Wounds UK, 2016). The wounds were photographed and pain and QoL were evaluated using a visual analogue scale throughout the study period *(Tables 1, 2, 3)*. The Tissue Viability Team managed the care of every patient for the duration of the application of compression strapping to ensure continuity. The introduction of the compression strapping was the only change in the treatment regime for all the patients. Pseudonyms have been used to protect the identity of the patients and all patients gave consent for their images to be used.

Case 1

Mr Y is a 69-year-old gentleman who was referred to Leg Clinic with a 14-month history of a VLU to the right medial retromalleolus *(Figure 2)*. The key factors for this gentleman were that he is 1.98 m tall with a body mass index (BMI) of 38 and he had foot and ankle oedema. He was seen by the Vascular Team who suggested weight loss. Various primary treatments had been utilised during this time and he had been prescribed oral antibiotics on occasion. Despite treatment with standard graduated high compression at 40 mmHg during this entire period, his wound failed to heal, and his foot and ankle oedema did not resolve. His leg was not causing him pain although it had been painful in the past.

CASE 2

Figure 4. Mr Z's right retromalleolar ulcer prior to commencement of strapping technique

Figure 5. Mrs Z's right medial retromalleolar ulcer 3 weeks later

Figure 6. Mrs Z's ulcer healed 9 weeks later

Compression strapping was commenced in November 2018 and his wound healed 7 weeks later *(Figure 3)*.

Case 2

Mrs Z is an active 74-year-old lady who had a longstanding history of recurrent mixed aetiology leg ulceration since 2012. She had undergone successful distal angioplasty in January 2018 and Vascular surgeons had discharged her from their care. Mrs Z was referred to the Leg Clinic with non-healing wounds to right medial and lateral malleoli with atrophy blanche breakdown. Severe pain and infection had become a recurring theme for Mrs Z. The key factors were that Mrs Z is tall (1.7 m), she has long, slim legs and a BMI of 19. Standard graduated high compression bandaging reduced oedema to the foot and leg and the lateral wound responded to the treatment. The medial wound continued to deteriorate and the medial retromalleolar oedema did not resolve *(Figure 4)*. The team struggled with exudate management despite the use of super absorbent dressings. Mrs Z described severe pain, scoring 10/10 and had become low in mood reporting a QoL score of 3/10.

The strapping technique was commenced January 2019 and the impact was dramatic *(Figure 5)*; her pain score reduced to 6/10 by week 3 and her QoL score rose to 10/10 at week 6. The wound healed 9 weeks after commencing the compression strapping *(Figure 6)*.

Case 3

Mrs X is an active 61-year-old lady who was referred to the Leg Clinic with recurrent VLU; the duration of the current breakdown to her right retromalleolus was 16 months *(Figure 7)*. The key factors for this lady were long periods of time standing at work (12 hours/day); she was a smoker and had a BMI of 36. Despite treatment with standard graduated high compression and a variety of advanced primary dressings, her wound failed to progress to healing.

Compression strapping was started in October 2018 and at this time her reported pain score was 4 /10 and her QoL score was 4/10. Four weeks later her reported pain score reduced to 0/10 and her QoL score increased to 8/10. Her wound healed 8 weeks after compression strapping commenced *(Figure 8)*.

DISCUSSION

Whilst this may only be a small subset of patients, the implementation of this novel compression technique had a significant impact on patient outcomes, supporting the findings of Hopkins et al (2011). The strapping technique was the only variation to the patient's treatment and the Solent Tissue Viability Team believe that this was instrumental in the healing of their leg ulcers, reducing their pain and increasing their quality of life. The patients all tolerated the strapping well and reported that it was comfortable. The use of compression strapping required continuity, motivation and consistency within the team, as well as full engagement from the patients. Although the technique required some additional education, it was easily adopted, and staff quickly reported that they felt competent and confident in its application. The success of the treatment can also be accredited to the trusting relationship between patient and clinician and their willingness to try an alternative treatment. Consequently, the Solent Tissue Viability Team has continued to use compression strapping for individuals with retromalleolar ulcers.

CONCLUSION

In this case study series, utilisation of the compression strapping technique reduced pain and improved the quality of life of individuals with hard-to-heal retromalleolar ulcers. In this case series, all the individuals retromalleolar ulcers healed with the addition of compression strapping. It was well tolerated by patients and staff found the application to be straight forward and easy to master; all parties were very pleased with the treatment outcomes. These clinical case studies demonstrate that the use of compression strapping can improve outcomes for individuals with hard-to-heal retromalleolar ulcers. WUK

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CASE 3

Figure 7. Mrs X's right retromalleolar ulcer prior to commencement of strapping technique

Figure 8. Mrs X healed 8 weeks later

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