

Neuromuscular electrostimulation for hard-to-heal leg ulcers

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Despite advances in wound care, treatment of lower limb ulceration remains suboptimal, with poor outcomes often attributed to inadequate diagnosis, failure to follow evidence-based practice, and variations in care delivery. These shortcomings result in delayed healing, reduced quality of life (QoL), and a significant economic burden on healthcare systems. Compression therapy is the recommended treatment for venous ulcers and ulcers with mixed aetiology, however there are some individuals who may not respond to compression alone or who are unsuitable due to arterial status. Recent advances in adjunctive therapies, such as the geko® device, offer promising results for these patients. This neuromuscular electrostimulation (NMES) device activates the calf and foot muscle pumps, increasing venous, arterial and microvascular blood flow. This article examines the impact of leg ulceration on healthcare services and patient outcomes, while exploring the potential of the geko® device to improve healing rates and reduce associated costs.

KEYWORDS:

■ Leg ulcers ■ Economic burden ■ Quality of life ■ Assessment
■ Compression therapy ■ Neuromuscular electrostimulation (NMES)

Leg ulcers are wounds located on the lower leg, typically between the knee and the malleolus, which have not healed after two weeks (National Institute for Health and Care Excellence [NICE], 2013). Leg ulceration can result from various causes, including venous disease, peripheral arterial disease (PAD), mixed venous and arterial disease, lymphoedema, and atypical aetiologies (Isoherranen et al, 2023). This list is not exhaustive, and many leg ulcers are, in fact, multi-aetiological, where multiple comorbidities may contribute to the development of the ulceration (Isoherranen et al, 2023). This article focuses on the most common types

of leg ulcers: venous, mixed, and arterial ulcers.

It has been well documented that treatment of lower limb ulceration is often suboptimal (Gray et al, 2018; Guest et al, 2018; Phillips et al, 2020). Poor outcomes for patients with leg ulcers have been attributed to many factors, including:

- ▶ Inadequate diagnosis
 - ▶ Inability to identify wound type correctly
 - ▶ Underuse of evidence-based practice
 - ▶ Variations in care
- (Gray et al, 2018; Guest et al, 2018; Phillips et al, 2020).

Failure to diagnose wound aetiology correctly and implement best practice guidelines can result in delayed wound healing, negatively affect an individual's quality of life (QoL), and significantly increase the economic burden that chronic wounds impose on healthcare systems (Guest et al, 2018; Phillips et al, 2020).

ECONOMIC BURDEN OF LEG ULCERATION

Guest et al (2020) reported that approximately 2% of the adult population in the UK experiences lower limb ulceration, with venous leg ulcers (VLUs) being the most prevalent type (Gray et al, 2018; Wounds UK, 2019). Compression therapy is recommended as first-line treatment for VLUs (Wounds UK, 2019; Isoherranen et al, 2023; National Wound Care Strategy Programme [NWCSP], 2024). Despite this, several studies have highlighted significant shortcomings in the care of individuals with VLUs, such as failure to exclude PAD through ankle brachial pressure index (ABPI) measurements and the lack of appropriate initiation of compression therapy (Gray et al, 2018; Guest et al, 2018; Phillips et al, 2020). These care deficiencies contribute to the economic strain on an already overburdened healthcare system (Wounds UK, 2022).

Guest et al (2018) estimated that the annual cost of treating a leg ulcer is approximately £7,500, but this figure increases by four to five times when the ulcer remains unhealed. More recently, Phillips et al (2020) estimated that the cost of treating VLUs in Wales accounts for approximately 1.2% of the NHS budget, with costs exceeding £2 billion across the UK.

The majority of leg ulcer care is delivered by community nurses (Guest et al, 2018; Phillips et al, 2020), making the time spent on community nursing visits a significant cost driver. This places additional strain on healthcare resources, particularly considering the 43% reduction in the number of community nurses over the past decade (Queen's Nursing Institute [QNI], 2019).

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The geko[®] device reduces pain fast¹ and doubles the rate of healing in venous leg ulcers versus compression alone²

VLUs affect one in
500 adults in the UK³,
costing the national
healthcare system around
£2 billion annually³

The study compared standard
of care with and without
the geko device in patients
with hard-to-heal VLUs²

The geko device, a
neuromuscular electrostimulator,
increases venous, arterial and
microcirculatory blood flow¹,
transporting oxygenated blood
to the wound bed accelerating
wound healing⁴

Reduces pain fast¹
Accelerates healing²
Improves concordance⁵

Available on prescription and NHSSC



The potential to positively influence cost drivers, such as prolonged healing times and excessive use of non-evidence-based care, as well as reducing nursing time spent on patient care, lies in practices that include minimising variations in care, ensuring patients undergo full comprehensive assessment (*Table 1*), accurately identifying wound aetiology, and implementing a standardised approach to care delivery (NWCSP, 2024).

IMPACT OF LEG ULCERATION ON QUALITY OF LIFE

A non-healing leg ulcer can have a significant impact on an individual’s QoL and may be multifaceted (Isoherranen et al, 2023). Patients’ experiences can vary and poor QoL has been associated with:

- ▶ Embarrassment due to leakage from exudate and odour
- ▶ Pain
- ▶ Reduced mobility
- ▶ Anxiety
- ▶ Depression
- ▶ Social isolation
- ▶ Sleep disturbance

(Harding et al, 2015).

In addition, time lost from work and the potential financial consequences can increase the stress and anxiety an individual experiences (Joaquim et al, 2018). Failure to consider the patient’s experience when planning care may lead to a lack of alignment in the care process and diminished trust in both the clinician and recommended treatment (Isoherranen et al, 2023). Furthermore, proactive symptom management has been demonstrated to improve patient QoL and encourage patient engagement (Weir and Davies, 2023).

Pain is one of the most reported symptoms of a leg ulcer, with estimates suggesting that up to 80% of patients experience mild-to-moderate pain (Leren et al, 2020). Wound-related pain is complex and multidimensional, influenced by various factors such as infection, tissue damage, nerve involvement, ischaemia, psychological factors, and medical procedures, such as

Table 1: Components of comprehensive leg ulcer assessment (adapted from Harding et al, 2015; NWCSP, 2024)

History	<ul style="list-style-type: none">▶ Wound history — duration of wound, how it occurred, previous ulceration and treatment▶ Patient history — comorbidities and medications
Examination	<ul style="list-style-type: none">▶ Size of wound▶ Tissue within the wound bed▶ Presence of infection▶ Exudate volume▶ Edge of wound▶ Condition of surrounding skin
Pain	<ul style="list-style-type: none">▶ Measure type of pain (e.g. procedural, nociceptive or neuropathic)▶ Record duration of pain▶ Measure level of pain using a validated measurement tool▶ Establish current analgesia regimen and its effectiveness▶ Identify any coping mechanisms the patient uses to manage or reduce pain (Holloway, 2024)
Nutrition	<ul style="list-style-type: none">▶ Use a validated nutritional assessment tool
Psychological needs	<ul style="list-style-type: none">▶ Establish what is important to the patient and how this can be achieved through common goals
Vascular status	<ul style="list-style-type: none">▶ Undertake ABPI/ toe brachial pressure index (TBPI) to exclude or confirm the presence of peripheral vascular disease
Establish a diagnosis	<ul style="list-style-type: none">▶ Use the information from the assessment to formulate an accurate diagnosis
Formulate treatment plan based on assessment findings and diagnosis	<ul style="list-style-type: none">▶ Use national guidance to formulate plan of care according to aetiology and wound environment▶ Where possible, empower the patient to be involved in the planning of care

dressing changes and debridement (Holloway et al, 2024). Holistic pain management starts with accurately identifying the type of pain (*Table 1*), recognising any triggers, and utilising a validated pain assessment tool. After this, appropriate interventions for effective pain management can be identified and implemented (Holloway, 2024).

AETIOLOGY AND TREATMENT OF LEG ULCERATION

Treatment of a leg ulcer depends on its aetiology (Sibbald et al, 2024). This is achieved through undertaking a comprehensive assessment within 14 days of first presentation (*Table 1*).

Venous leg ulcers result from venous hypertension, which is attributed to valve incompetence and poor calf muscle function (Wounds UK, 2024). This leads to lower limb oedema, skin changes, and ulceration (Sibbald et al, 2024). First-line treatment for a venous leg ulcer is the

use of high-level compression therapy (40mmHg) to assist in reversing venous hypertension and reducing oedema (NWCSP, 2024).

Arterial ulcers are caused by PAD, which is a narrowing in the peripheral arteries with fatty deposits restricting the oxygen supply to surrounding tissue (Isoherranen et al, 2023). Patients with arterial ulcers require rapid referral to the vascular team to assess for the potential for revascularisation (Sibbald et al, 2024).

Mixed aetiology ulcers have elements of both venous and arterial disease. Referral to vascular services is recommended to establish level of PAD. Treatment with reduced compression (20mmHg) can be started if oedema is present and there are no red flags or evidence of acute or limb threatening ischaemia (NWCSP, 2024).

There are some patients that fail to heal despite optimum use of compression therapy, and there is

Red Flags

Refer immediately to the appropriate specialty if patient displays any of the following:

- Acute infection
- Symptoms of infection
- Acute or suspected limb threatening ischaemia
- Suspected deep vein thrombosis (DVT)
- Bleeding varicose veins

(NWCSP, 2024).

also a small proportion of patients who are unable to tolerate the recommended level of compression due to pain or vascular status (Stacey et al, 2024). For these patients, adjunctive therapies such as a neuromuscular electrostimulation (NMES) device, i.e. geko®, may be considered (Sibbald et al, 2024).

WHAT IS NMES — GEKO®?

The geko® device is a compact, disposable, battery-powered neuromuscular electrostimulator designed for external application to the leg. This self-adhesive device is placed on the outer side of the knee, where the peroneal nerve bifurcates. The built-in electrodes stimulate the common peroneal nerve, which controls muscle contractions in the calf and foot. By stimulating this nerve, the device can activate the calf muscles to contract isometrically without interfering with normal limb movement or patient mobility. This muscle contraction increases blood flow from the lower limbs to the heart, improving venous return, enhancing local circulation, and reducing the risk of venous thrombosis (Bosanquet et al, 2021; Das et al, 2021).

The geko® device is CE marked and the intended use is for:

- ▶ Increasing blood circulation
- ▶ Promoting wound healing
- ▶ Treatment of venous insufficiency and ischaemia
- ▶ Prevention and treatment of oedema.

The geko® device may be considered for lower limb wounds if there is no improvement following 28 days of standard care treatment. A

pathway to support appropriate use of geko® is provided in *Figure 1*.

Evidence for geko® in clinical practice

A study by Bosanquet et al (2020) sought to measure the effect of NMES of the common peroneal nerve using the geko® device on blood flow in eight patients with arterial ulcers. Mean blood flow (flux) and pulse amplitude (pulsatility) were measured at baseline and at intervention. All eight patients showed a significant increase in perfusion to both the wound bed and the surrounding peri-wound area while using the geko® device. Bosanquet et al acknowledged that this was a small study and recommended larger cohort studies.

However, the findings suggest that the geko® device may positively impact healing by increasing blood flow to the wound bed in patients who are unable to undergo revascularisation.

Bull et al (2023) conducted a self-controlled study involving 60 patients with venous leg ulcers which had been present for more than six weeks. The primary outcome was the rate of healing, measured by the advancement of the wound margin. This novel approach enabled the study to be conducted over a shorter period (four weeks), in contrast to most randomised controlled trials (RCTs) that use complete healing as the endpoint, which typically extends the study duration. Additionally, this

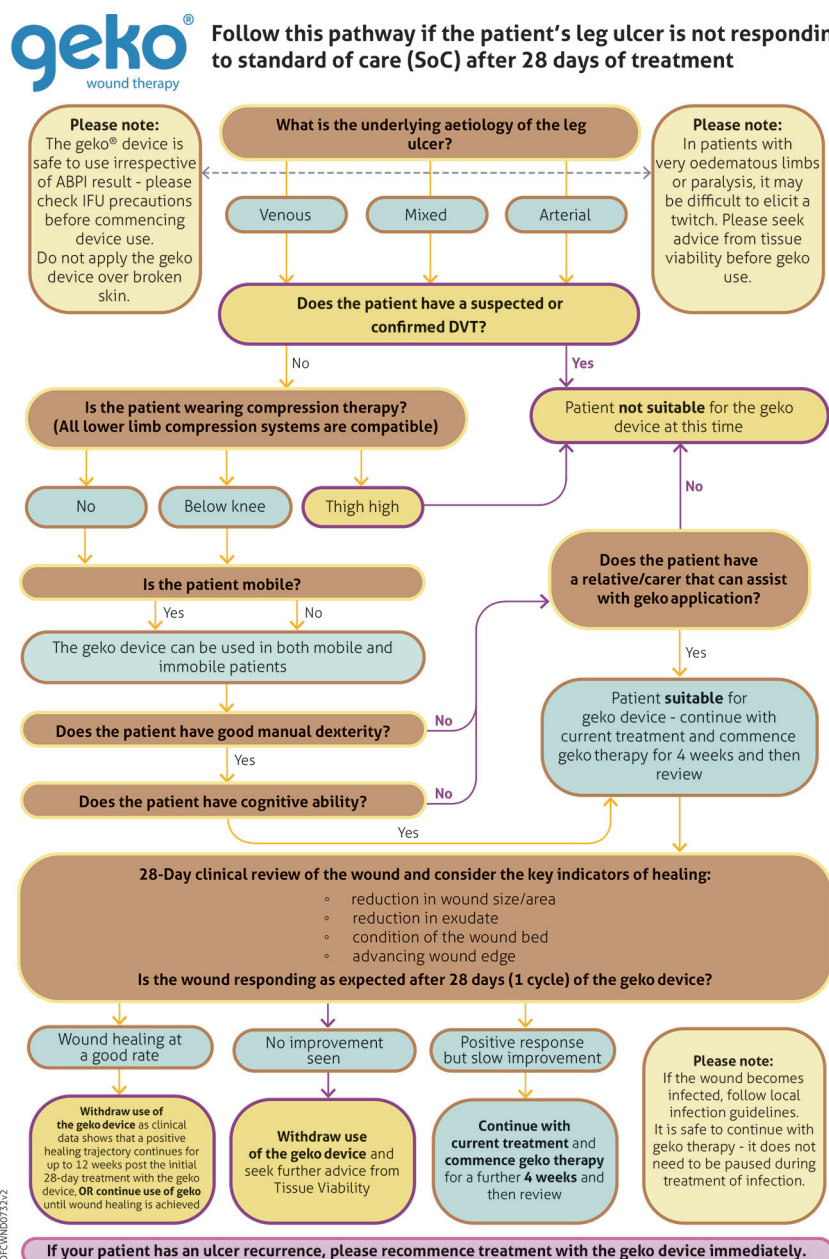


Figure 1.
Wound care pathway using geko® device.

method accounts for the variability in chronic ulcers, which may follow different healing trajectories.

Twenty-two patients were randomly assigned to receive the standard of care (SoC), which included compression therapy (either multilayer compression bandages or compression hosiery). An additional 29 patients were randomised to receive SoC plus NMES for 12 hours per day (nine patients were withdrawn post randomisation). The study demonstrated that in the group that received compression plus NMES, healing rates over the four-week period increased two times faster than the compression alone group. At three-month follow-up, 42% in the compression plus NMES group had healed compared to 27% in the control group. Reduction in pain was also much greater in the NMES group. Furthermore, patients reported that the NMES device was easy to use and did not report any issues with application and use of the device.

Tuson et al (2024) evaluated the cost-effectiveness of the geko® device in a RCT conducted across multiple centres in the UK. The trial involved 51 patients with chronic venous ulceration over a 12-month period, with 29 patients in the intervention group (geko® plus SoC — compression therapy) and 22 in the control group (SoC alone). The primary aim was to assess potential cost savings for the NHS, measured by the incremental cost per quality-adjusted life year (QALY). The study indicated that combining geko® with SoC increased healing rates significantly compared to SoC alone (25.3 weeks versus 37.6 weeks respectively). Tuson et al further concluded that the healing rate could potentially be increased by 68% resulting in an estimated cost saving of £774.14 per patient following the implementation of the geko® device alongside SoC. The potential cost savings could help alleviate the financial burden associated with chronic leg ulcers by improving healing rates and enabling more efficient resource allocation, including reduced district nurse time and decreased use of wound care products.

Case series

The first author conducted a case series evaluation on the use of a NMES device (geko®) as an adjunctive therapy to SoC (compression therapy) for a four-week period in five patients with chronic, non-healing venous leg ulcers (*Figure 2*) (Collarte, 2024).

Patients were given full instructions on how to apply and remove the device and all five patients wore it for 12 hours per day, seven days per week. Patients continued with SoC during the evaluation period and were evaluated by a specialist nurse. The rate of wound healing was calculated on day 28 and day 56 as part of the normal clinical review process. This was a standard clinical assessment (aligned to the patient pathway). Patients were asked to verbally report levels of wound-related pain using a numerical rating scale of 0–10, both before and during treatment with NMES. Patient acceptance of and ability to self-manage were also recorded.

As said, the geko® device was used alongside compression therapy for four weeks. After this period, two patients had fully healed, while the remaining three continued treatment for an additional four weeks, ultimately resulting in complete healing for all patients (*Figure 2*). Two patients reported pain at the start of the intervention, both of whom experienced pain reduction after using the device. All patients found the device easy to use.

This case series demonstrates how the NMES device was used to manage a group of patients with non-healing, chronic venous leg ulcers in a real-world clinical setting. The results of this evaluation emphasise the advantage of integrating the NMES device into a leg ulcer treatment regimen and demonstrated improved healing and health economic outcomes for patients with VLUs who were not previously responding to SoC protocols.

Case reports one and two provide further information on the use of the geko® device in clinical practice.

CONCLUSION

Chronic leg ulcers are among the most common types of wounds, significantly increasing healthcare costs and negatively affecting patient QoL. Successful treatment hinges on conducting a thorough assessment and establishing an accurate diagnosis to provide the most appropriate care for wound healing. However, a small subset of patients may not tolerate treatments like compression therapy, or fail to respond to it, while others may be unsuitable candidates for revascularisation. For these patients, adjunctive therapies such as NMES (geko®) may be of benefit.

Studies have demonstrated the effectiveness of geko® in enhancing wound healing, particularly in patients with non-healing ulcers or those unable to tolerate high-level compression therapy. Clinical trials have shown significant improvements in healing rates, pain reduction, and overall patient satisfaction with the geko® device. Additionally, the device offers potential cost savings by reducing treatment duration and resource utilisation, including nursing time and wound care product usage. By improving healing rates and reducing care variability, adjunctive interventions like the geko® device may help alleviate the financial burden of chronic leg ulcers on healthcare systems while improving patient QoL. **JCN**

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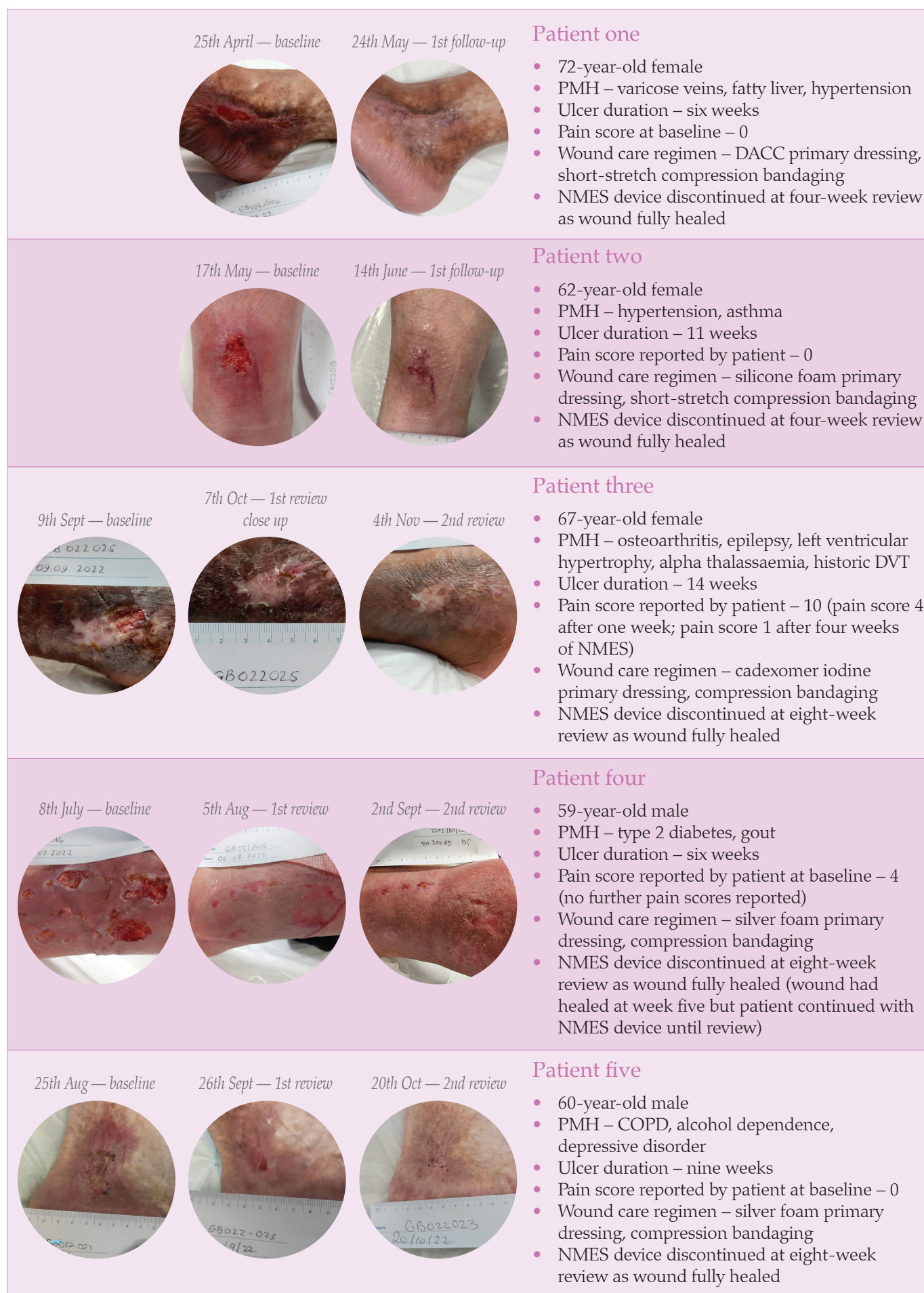


Figure 2.
Case series of five patients who used the geko® device.

CASE REPORT ONE

Mrs Watts was a 78-year-old female who was referred to the tissue viability team with a large wound to her right lower leg that had been present for two months. She lived with her husband and relied on a wheelchair to go out due to extreme wound pain. Due to leaking bandages, Mrs Watts slept in a chair as she did not want to ruin the mattress on her bed. Her past medical history included:

- ▶ Hypothyroidism
- ▶ Closed fracture of the lateral malleolus
- ▶ Seropositive rheumatoid arthritis
- ▶ Thyrotoxicosis
- ▶ Total knee replacement.

On initial assessment, the leg ulcer was almost circumferential measuring 19.0x22.8cm. The wound bed was covered with 90% slough and 10% granulation tissue (*Figures 3 and 4*). The presence of oedema and cellulitis was noted to the limb and the periwound skin was macerated due to a high volume of exudate. At the time of the assessment, the ankle measured 26.8cm and calf 43.2cm. Ankle brachial pressure index (ABPI) measurements were right limb=0.96, left limb=1.02. The wound was diagnosed as a venous ulcer.

Mrs Watts reported continuous pain at a severe level of 10 using a verbal numerical rating scale of 0–10 (where 0=no pain and 10=worst pain). For pain management, she relied on co-codamol 30mg/500mg, taking two tablets four times a day. She was unable to increase her analgesia due to various previous drug reactions, which meant that her pain was not adequately controlled.

Despite various previous treatments with antimicrobial dressings and reduced compression therapy, Mrs Watts' wound was showing no signs of healing. Due to her numerous allergies, she was anxious about trying new dressings as she thought that they may increase her pain and cause her wound to deteriorate.

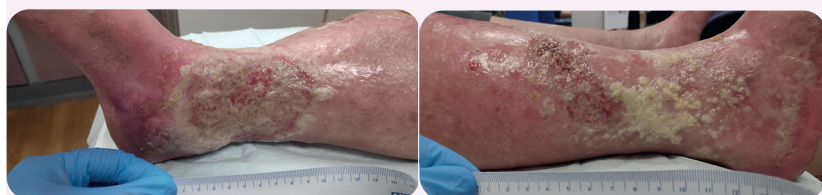
Due to the static nature of the wound and severe pain experienced, treatment with a neuromuscular electrostimulation (NMES) device (geko®) was discussed as a wound management option, with the aim of preventing further infection, reducing pain and exudate volume, decreasing oedema, and promoting healing. The treatment regimen included the use of dressings, reduced compression bandaging, and the geko® device.

Mrs Watts was reluctant at first but eventually agreed to the geko® device. She was given education on how to apply and remove it and an appropriate skin care regimen to prevent further skin breakdown. She wore the geko® device for 12 hours per day, seven days per week.

Mrs Watts tolerated treatment with the geko® device well. After just 24 hours she reported that her pain had greatly reduced and that she was more than happy to continue with the therapy. Over the next 10 weeks her wound showed progress. It reduced in size and exudate volume decreased to the point where she was able to sleep in the bed with her husband again. Due to the reduction in pain, Mrs Watts could mobilise with the use of two sticks instead of using a wheelchair. She was also able to tolerate 40mmHg compression instead of a reduced bandage system. By the end of the treatment period with the geko® device, her ankle circumference measured 21.5cm and her calf 33.3cm.

The tissue viability team were amazed at the improvements in Mrs Watts' wound after adding the geko® device to her treatment regimen. After 10.5 weeks her wound measured 2x2cm and treatment with the device was discontinued (*Figure 5*). Her wound went on to completely heal three weeks later.

This case emphasises the challenges patients living with chronic wounds often face, as well as for clinicians. In this case, there was minimal choice in treatment options due to the patient's previous adverse reactions. Through integrating geko® device therapy into the wound management plan, Mrs Watts' wound and associated symptoms improved significantly, highlighting the importance of adaptive treatment strategies to achieve better outcomes for patients with non-healing wounds.



Figures 3 and 4.
Initial presentation (15th January, 2024).



Figure 5.
At 10.5 week assessment (2nd April, 2024).

CASE REPORT TWO

This case describes the wound management of Jack (pseudonym), a 67-year-old gentleman with a mixed aetiology wound to his leg and a neuroischaemic ulcer to the dorsum of his foot, which had both been present for over five years. Jack had an extensive medical history of double heart bypass surgery, cerebrovascular accident (CVA) and type 2 diabetes, which was controlled with both insulin and tablets. Jack lived alone and had limited mobility, using a mobility scooter to get around.

Jack was referred to the practice nurse by his GP for assessment and management of a non-healing wound to the pre-tibial area of his left leg. He was already under the care of the specialist podiatrist for management of his diabetic foot ulcer. On presentation, his leg wound measured 2.5cm length and 3.5cm width, with 80% granulation tissue and 20% slough and minimal exudate. Jack reported a pain score of 5/10 and was taking gabapentin regularly. The aims of wound management were to reduce oedema and heal both the wound to his leg and to the dorsum of his foot.

Compression therapy was contraindicated due to the risks to his neuroischaemic diabetic foot wound. As Jack's wounds were showing no signs of healing, it was decided that a neuromuscular electrostimulation (NMES) device (geko®) should be added as an adjunctive therapy to the existing wound management regimen to aid healing by augmenting blood flow to his limb and wound beds.

Jack was taught how to apply and remove the NMES device, which was positioned to the skin over the common peroneal nerve at the head of fibula on his affected leg. A regular twitch of the foot indicated that the muscles were being stimulated. This optimum positioning of the device was marked so that he could change the device at home on a daily basis. The usage was 12 hours on and 12 hours off each day for seven days a week.

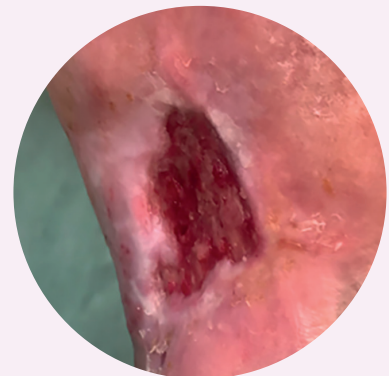
Jack was keen to have the NMES device added to his wound management regimen. It gave him hope that his wounds might eventually be healing after being present for so long. He found the application and removal of the NMES device extremely easy and both his leg and foot wounds started to reduce in size. Jack reported a reduction in his pain and was able to lessen his use of analgesics. Over 12 weeks, both his wounds had reduced in size by approximately 50%. Jack reported that his mood had lifted due to the improvements in his wounds and the reduction in pain. He also stated that he enjoyed being able to take part in his own care as it made him feel involved and slightly more independent.

Having both a mixed aetiology leg ulcer as well as a neuroischaemic diabetic foot ulcer presented a challenge in deciding on the best wound management regimen for this patient. By adding the NMES device to standard care, Jack's wounds made significant progress after five years of non-healing. His quality of life improved and he felt involved in his wound care for the first time.

As demonstrated in this case, the NMES device provided an effective adjunctive treatment option for hard-to-heal lower limb wounds.



Leg wound at start of NMES treatment (day 0)



Foot wound after one week of NMES treatment



Leg wound after 12 weeks of NMES treatment



Foot wound at 12 weeks of NMES treatment

Figure 6.
Wound care progress of Jack's wounds using NMES treatment.

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As a clinician, making a meaningful difference to the lives of our patients is paramount. The widespread challenge of non-healing wounds highlights the critical need to address gaps in care by ensuring that treatments are

both evidence-based and cost-effective. For venous leg ulcers (VLUs), compression therapy remains the gold standard. However, healing may be stalled in some cases due to complex comorbidities or an inability to tolerate compression therapy. For these patients, adjunctive therapies such as neuromuscular electrostimulation (NMES) have demonstrated many significant benefits. In my experience, the geko® device has proven to be a valuable addition to standards of care, delivering positive outcomes by accelerating healing, reducing wound-related burdens, and enhancing patient quality of life. Notably, its use has also been associated with a marked reduction in pain, further supporting patient comfort and recovery.

Patient stories serve as a compelling way to highlight the transformative impact of innovative treatments. Our patient accounts have consistently demonstrated the meaningful difference the geko® device has made in their lives, offering renewed hope for healing their wounds. Moreover, these experiences highlight the significant positive effects on aspects of daily living that are most important to them, enhancing their overall quality of life.

Providing a solution that fosters hope and optimism in patients can improve adherence to treatment plans, empower individuals to take greater control over their care, and ultimately contribute to better outcomes. By integrating therapies like geko® into the broader spectrum of wound care, we can continue to make a profound difference for our patients in clinical practice.

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