Journal of Vascular Nursing xxx (xxxx) xxx

Contents lists available at ScienceDirect

Journal of Vascular Nursing

journal homepage: www.sciencedirect.com/journal/journal-of-vascular-nursing

Exploring patients' experiences of using Transcutaneous Electrical Nerve Stimulation for Claudication

Chris Seenan[a,*], Stephanie Hill[b], Ukachukwu Abaraogu[c], Stephen McSwiggan[d], Patricia A Roche[e,i], Chee-Wee Tan[e,h], Tom Mercer[f], Jill Belch[g]

[a] University of Stirling, Stirling, UK
[b] Glasgow Caledonian University, Glasgow, UK
[c] University of the West of Scotland, Paisley, UK
[d] Tayside Medical Science Centre, Dundee, UK
[e] Singapore Institute of Technology, Singapore
[f] Queen Margaret University, Edinburgh, UK
[g] University of Dundee, Dundee, UK
[h] West Lothian College, Livingston, UK
[i] Pain Concern, Edinburgh, UK

Background: Pain associated with claudication in peripheral arterial disease (PAD) is a key barrier to physical activity, limiting walking ability and impacting quality of life. Transcutaneous Electrical Nerve Stimulation (TENS) may offer non-pharmacological pain relief and has shown potential to improve walking performance. However, little is known about patients' experiences using TENS in everyday life.
Aim: To explore the lived experience of using TENS at home among individuals with PAD and claudication.
Methods: Six participants with PAD and claudication received training in the use of a TENS device for home use during daily walking activities. After four weeks, experiences were explored through a focus group and an individual interview. Data were analysed using thematic analysis.
Results: Four themes emerged: Pain, Expectations, Usability, and Physical and social functioning. While some participants reported reduced pain and improved walking ability, others expressed disappointment when TENS did not fully meet their expectations. Variability in use and perceived benefit was influenced by prior knowledge, usability challenges, and personal preferences.
Conclusions: TENS may support self-management of claudication pain and enhance physical activity in some individuals with PAD. However, managing patient expectations and addressing device usability are essential to optimise outcomes. Healthcare practitioners may play a key role in supporting education, tailoring advice, and evaluating the appropriateness of TENS as part of individualised care plans.

Introduction

Peripheral artery disease (PAD) affects an estimated 236 million people worldwide, with prevalence increasing with age.[1] Claudication, the hallmark symptom of PAD, is characterised by exertional leg pain caused by impaired arterial blood flow and affects approximately 10–20 % of those with the disease.[2–4] Claudication is associated with impaired mobility, reduced quality of life, and heightened cardiovascular risk.[5–7]

Individuals with PAD and claudication are less physically active than those without the disease.[8,9] Physical inactivity is an independent predictor of disease outcomes and all-cause mortality in people with claudication[10] hence, increasing and maintaining a physically active lifestyle is essential to realise improvements in symptoms, cardiovascular risk factors, overall health and quality of life.[11]

Current clinical guidelines recommend Supervised Exercise Training (SET) as the primary treatment for claudication with high quality evidence for effects.[12,13] However, in the UK and internationally, access to SET remains limited due to staffing, facility, and funding constraints.[14–19] Where available, challenges such as the time and travel required for regular attendance, multiple comorbidities, lack of motivation to exercise, and poor understanding of

* Correspondence author at. Faculty of Health Sciences and Sport, University of Stirling, Stirling, FK9 4LA, Scotland UK.
E-mail address: Christopher.seenan@stir.ac.uk (C. Seenan).

https://doi.org/10.1016/j.jvn.2025.11.004

the disease result in low uptake and adherence.[15,16,20] The pain associated with claudication is frequently cited by patients as a barrier to initiating or sustaining physical activity.[21,22]

Despite it being a central factor of the disease process, there are no interventions recommended for managing the pain experience associated with claudication while walking. Interventions that reduce the burden of claudication could help to encourage adherence to exercise therapy and thus reduce the risk of future serious cardiovascular events. Transcutaneous Electrical Nerve Stimulation (TENS) is a safe, non-pharmacological and cheap method of providing non-invasive pain relief and may be useful for people with PAD and claudication.[23,24] TENS has been found to increase time to pain threshold and tolerance to induced lower limb ischaemic pain in healthy volunteers[25] and people with PAD and claudication walk further on a treadmill when using TENS for pain relief.[24,26]

While clinical studies provide evidence for the efficacy of TENS in controlled settings, understanding how individuals experience and engage with such interventions in their daily lives is essential.[27] Exploring acceptability and lived experience can reveal barriers and facilitators to real-world use, informing the development of interventions that are not only effective but also implementable, person-centred, and sustainable in routine care.

Although previous studies have examined the experience of living with PAD and claudication[28–30] and the use of TENS in other conditions,[31,32] little is known about how people with PAD experience using TENS in their own homes and routines. The aim of this study was to investigate the lived experience of using TENS at home for daily life in people with PAD and claudication.

Material and methods

Study design and rationale

This study employed an interpretive qualitative design to explore the lived experiences of using TENS in daily life with PAD, with a pragmatic focus on feasibility and acceptability. A single focus group was conducted as a 'follow-up' to a previously published clinical trial.[24] Focus groups are well established as a method for eliciting interactive discussion that surfaces practical, emotional, and contextual aspects of intervention use.[33] At this early feasibility stage, the aim was not to achieve saturation but to generate indicative insights to guide whether and how to progress to larger-scale evaluation.[34,35] A single, well-facilitated group with six participants provided sufficient depth to explore usability and acceptability issues while being proportionate to the exploratory nature of the study.[36] This design also reflected ethical and pragmatic considerations: participants represented a finite pool of individuals trialling the device, and convening multiple groups could have placed unnecessary burden on them at a stage when effectiveness had yet to be demonstrated.

Research team and reflexivity

The primary researcher (CS) is a Health and Care Professions Council (HCPC)-registered physiotherapist and researcher with clinical and academic expertise in pain and vascular disease. His dual role as a clinician and researcher shaped the study design, particularly in relation to selecting meaningful outcome measures and developing the topic guide. This background facilitated rapport and empathetic interviewing but also required ongoing reflexivity to mitigate potential bias in data interpretation. An independent researcher unfamiliar to participants was also involved in field note collection and data interpretation to enhance trustworthiness.

Reflexive practices included maintaining a research diary, engaging in peer debriefing, and involving an independent researcher in coding and analysis to challenge assumptions and enhance analytical rigour. Participants were made aware of the researcher's background and the purpose of the study to promote transparency and trust.

Participant selection and recruitment

A convenience sample was drawn from the clinical trial cohort in which participants used TENS while walking on a treadmill.[24] All ($n = 40$) participants who had completed the previous trial were contacted by letter 3 months after completing the initial study and invited to participate. To pragmatically support the organisation of a single focus group, the first six respondents were enrolled. All participants provided informed written consent prior to data collection.

Eligibility criteria for this follow-up study included a clinical diagnosis of PAD with stable claudication of ≥3 months duration, Fontaine stage II classification, resting ankle-brachial index (ABI) <0.90 in at least one leg, and functional mobility without walking aids. Participants were excluded if they were under 40 years of age, had planned revascularisation procedures, comorbid lower-limb pain, significant fall risk, sensory deficits, cardiac pacemakers, epilepsy, psychiatric illness, or prior independent experience with TENS.

Data collection

Data collection occurred in two stages. At an initial hospital visit, participants completed a demographic and clinical profile using validated questionnaires, including the Walking Impairment Questionnaire (WIQ; scores 0–100, higher = less impairment)),[37] Pain Self-Efficacy Questionnaire (PSEQ; 0–60, higher = greater self-efficacy),[38] Pain Catastrophising Scale (PCS; 0–52, higher = more catastrophising),[39] Tampa Scale of Kinesiophobia (TSK; 17–68, higher = greater pain-related fear),[40] International Physical Activity Questionnaire (IPAQ; 1–3 activity categories),[41] and the Vascular Quality of Life Questionnaire (VASCUQOL; 0–6, higher = better quality of life) .[42]

ABI and treadmill outcomes (initial, functional, and absolute claudication distance) were taken from the parent clinical study for descriptive context only; no new treadmill testing was conducted as part of this study.

Participants were then issued a TENS device and trained in its operation by the lead researcher. Standardised written instructions, supplementary information, spare batteries, and electrodes were provided. Participants were advised to use the device during activities where they typically experienced claudication pain.

After four weeks, participants returned for a focus group conducted in the same hospital setting. At this second visit, they again completed the IPAQ, VASCUQOL, and the Patient Global Impression of Change (PGIC) scale[43] (relating to both activity limitation and perceived effect of TENS). The focus group was moderated by the lead researcher, with observational notes recorded by an independent researcher.

The topic guide (Fig. 1) was developed by the research team, informed by previous PAD and pain literature, and reviewed by a vascular nurse specialist to ensure clinical relevance. Areas covered included symptom experience, device usability and participant expectations. While not formally pilot-tested, feedback from the nurse specialist informed refinement of wording and order.

We used deliberately polarising written statements as stimulus material in the focus groups to encourage participants to reflect on their experiences of using the TENS device at home. This technique is well established in focus group research as a way of stimulating interaction and surfacing perspectives that may not arise through

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Start with introducing focus group and purpose of discussions: to elicit participants' experiences of living with PAD and IC and using TENS for walking.

- Thank you very much for coming along today. Can you please, as an introductory task, tell us your name and something you like to do in your spare time?
- You have all been invited along to this discussion as you have PAD and IC and have been issued with a TENS machine for the past month. I'd like you to speak freely and explain your own opinions and experiences in the discussion.
- I am going to read out a series of statements that will relate to your experiences. I would like you all to respond to these statements, contributing your opinions and sharing your views with each other

Present these statements, one at a time, to the participants (prompts if required)

- "Going for a walk is not a problem for me"
  - What factors, if any, affect your decision to go for a walk?
  - How do you feel when you know you have to walk somewhere?
  - Do you ever walk for pleasure/exercise?
- "There is nothing that I can do to about my disease"
  - Have you received/sought any advice?
  - What do you know about the disease?
  - How did you find this out?
  - What treatment options are available?
- "The worst part of the disease is the pain"
  - What frustrates you most about the disease?
  - When you think about your medical problems, what first jumps into your mind?
- "TENS is the perfect treatment for walking in IC"
  - Does TENS make any difference to you?
  - How does it affect your walking?
  - Does its effectiveness wear off?
- "TENS is easy to use for people with PAD and IC"
  - What would you change about it?
  - Would you use it differently?
- "TENS is not for me"
  - What is it about using TENS that you don't like?
  - Do you like the feeling of the stimulation?
  - Are you self-conscious when using TENS?
  - Do you tell people you are using it?
- "TENS reduces the pain experience of IC"
  - What changes, if anything, about the pain you feel in your legs when you use TENS?
  - Does it work in any other way?
- Do you have any other thoughts about TENS and/or walking activity that we may not have discussed already?

Fig. 1. The focus group Topic Guide employed within this study.

open questioning alone.[33,44] By presenting extreme or contrasting positions, the statements prompted participants to articulate and critically evaluate their own views, reducing the likelihood of only socially desirable responses and encouraging discussion of tacit assumptions.[45,46] Participants were briefed beforehand on the purpose of the exercise, reminded that disagreement was welcome, and signposted to support if needed. Statements were carefully worded to avoid derogatory or stigmatising language, ensuring an environment that was both ethically sensitive and conducive to rich, meaningful dialogue.

One participant, unable to attend the focus group, was interviewed by telephone using the same topic guide. The transcript was analysed alongside the focus group data and coded in the same way, ensuring equal weighting in the thematic analysis. At the end of both the group and interview sessions, participants were provided with a verbal summary of the discussion for immediate clarification and member-checking, although full transcripts were not returned.

The focus group lasted approximately 75 min. All data were audio-recorded, transcribed verbatim, and anonymised.

Data analysis

Data were analysed using thematic analysis, following the six-phase framework outlined by Nowell et al.[47] Transcripts were coded using NVivo 12 software (QSR International).[48] Coding was

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Table 1
Participant demographic data.

Participant	Age (years)	Disease Duration (months)	ABI	ICD	FCD	ACD	WIQ	PSEQ	PCS	TSK
1	68	24	0.57	270	931	1200	49	56	5	33
2	82	24	0.41	99	160	181	13	28	19	39
3	71	6	0.61	25	94	117	42	38	6	40
4	76	72	0.51	43	87	135	32	37	5	30
5	55	36	0.81	48	135	165	45	48	37	39

Key: ABI: Ankle Brachial Index; ICD: Initial Claudication Distance (m); FCD: Functional Claudication Distance (m); ACD: Absolute Claudication Distance (m); WIQ: Walking Impairment Questionnaire (%) (Greater score = less impairment); PSEQ: Pain Self-Efficacy Questionnaire (Greater score = greater pain self-efficacy); PCS: Pain Catastrophising Scale (Greater score = greater catastrophising beliefs); TSK: Tampa Scale of Kinesiophobia (Greater score = greater pain-related fear).

conducted independently by two researchers (CS, SH), followed by comparison and discussion to refine themes. This included: (1) data familiarisation, (2) initial coding, (3) theme development, (4) theme review, (5) theme definition and naming, and (6) report production. Coding was conducted independently by the lead researcher and a second analyst (SH), who was not involved in data collection. Peer debriefing and researcher triangulation were used to enhance analytical rigour. An audit trail documenting coding decisions, thematic refinements, and analytic memos was maintained throughout the process. Quotations were selected to illustrate theme content and preserve participant voice.

Ethical considerations

Ethical approval was granted by the local National Health Service Research Ethics Committee (Ref: 09/S1402/15). Participants were informed of their right to withdraw at any point without prejudice. All data were anonymised and securely stored in accordance with UK data protection regulations. The study was designed, conducted, and reported in line with the Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist.[49]

Results

Five participants (four men) completed the study; a sixth participant withdrew due to illness unrelated to the intervention. Demographic and clinical data are presented in Table 1. All participants were aged ≥55 years (mean = 70, range 55–82), with time since diagnosis ranging from 6 months to 6 years. All had iliofemoral disease with ABI values between 0.41 and 0.81.

There was notable heterogeneity across baseline measures. Participant 1 reported substantially greater ICD, FCD, and ACD than the others, as well as the highest IPAQ score and VASCUQOL, reflecting higher activity levels and better self-reported quality of life. In contrast, Participant 2, the oldest in the sample, had the lowest ABI, IPAQ, and VASCUQOL scores, though their walking distances were comparable to most others. Participant 4 recorded the highest PCS score, suggesting stronger catastrophic beliefs about pain. These variations illustrate the diversity of disease severity, functional capacity, and psychosocial profiles represented within the group (Table 1).

Thematic analysis generated four interconnected themes: *Pain, Expectations, Usability*, and *Physical and Social Functioning*. Each theme comprised several subthemes, developed from clusters of participant codes, and illustrated with representative quotations. These are summarised in Table 2, which outlines the analytic framework and demonstrates the progression from codes to subthemes and overarching themes. This provides transparency to the analytic process and highlights the diversity of experiences reported by participants.

Pain

Participants reported mixed effects of TENS during daily life. Some described reduced pain intensity or a “numbing” sensation, while others felt that the device provided little benefit. This variability illustrates the nuanced ways patients interpreted the impact of TENS.

> [P5] *it didn’t do me any good…the pain was still there when I was using it.*

> *[P3] I still had it (the pain) but it was a different form of pain ….. it was sort of numbing, not so sore but it was still there.*

> *[P1] (interview) I did have some pain but certainly nothing like what I would have expected to experience.*

TENS seemed to work immediately, delaying the initial perception of pain and continue throughout the experience, reducing the overall intensity.

> *[P3] yeah, it sort of numbed the pain, more concentrated, you know instead. The tingling takes it away right away, the initial pain. It was definitely as I say if, it has got potential; it is working on the right lines, it’s not taking the pain away, just covering it*

Expectations

One of the participants found that TENS helped them so much that they have ordered some more equipment for the TENS machine with a view to purchasing their own. This indicates that TENS had a beneficial effect on pain and walking for this participant and they felt like they would like to continue using it.

> *[P1] (interview) I will tell you how much I found how good, I have already been out and ordered, not that I have used them, but I have ordered myself some new pads.*

Another participant didn’t think that the TENS machine was useful for them. They reported that they still experienced pain and therefore they felt that TENS doesn’t work.

> *[P5] I would say it is easy to use but I don’t think it is any good for the disease, well that’s just my personal opinion, it didn’t do me any good. Well, the pain was still there when I was using it.*

It seems there was a mismatch between this person’s expectations and the reality of using the TENS device i.e., they thought TENS was going to take away the pain altogether rather than just reduce it.

When discussing the numbing nature of TENS, it was reported to be positive as less pain was experienced. However, some of the participants were not satisfied suggesting that they were expecting a greater degree of pain reduction.

> *[P5] I still definitely got the pain with it when I did use it, did you P3?*

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Table 2
Coding framework with themes, subthemes, and illustrative quotes.

Theme	Subtheme	Example Codes	Illustrative Quote
Pain	Partial relief	"Numbing pain," "less intense pain," "delayed onset"	*"I still had it [the pain] but it was a different form… it was sort of numbing, not so sore but it was still there." [P3]*
	Persistent pain	"Pain remains," "didn't work for me"	*"It didn't do me any good…the pain was still there when I was using it." [P5]*
	Variability of effect	"Works in some situations," "context dependent"	*"I did have some pain but certainly nothing like what I would have expected." [P1] (interview)*
Expectations	Unmet expectations	"Expected complete pain relief," "disappointment"	*"I thought it would take the pain away altogether, but it didn't." [P5]*
	Positive reinforcement	"Bought own pads," "would continue use"	*"I have already ordered myself some new pads." [P1] (interview)*
	Influence of prior knowledge	"Friend's positive TENS story," "familiarity shapes perception"	*"My friend… used it for her shoulder and said it worked perfect for her." [P3]*
Usability	Device design challenges	"Wires in trousers," "bulkiness," "awkward setup"	*"If it is on your legs, you've got to put the wires up through your trousers." [P1] (interview)*
	Sensory experience	"Unpleasant tingling," "enjoyable tingling"	*"The tingling in my legs…I can't bear it." [P5]; "I enjoyed that…it helped." [P4]*
	Patterns of use	"Used only for long walks," "all-day wear," "occasional use"	*"I use it only if I am going to be playing 18 holes of golf." [P1] (interview)*
	Social visibility	"Embarrassment when noticed," "willing to try anything"	*"Even adults were querying what it was. I am willing to try anything." [P3]*
Physical and Social Functioning	Increased walking ability	"Walk further," "pushed through pain"	*"It numbed the pain; you maybe walked a wee bit further." [P3]*
	Reduced social embarrassment	"Not stopping to shake leg," "less disruption"	*"I could never get round that course without stopping and shaking my leg, which becomes embarrassing." [P1] (interview)*
	Enhanced participation	"Golf," "bowling," "daily activities easier"	*"I find I could get round [the golf course] when I am using it." [P1]*

[P3] oh aye. Aye. I still had it but it was a different form of pain

[P5] right

[P3] it was sort of numbing, not so sore but it was still there

[P2] I didn't feel that this sort of alleviated the pain at all, I was aware of the pulsing as you are saying but to me it wasn't making things any better

In subsequent conversation, the participant who reported a positive experience of TENS explained that they had prior, indirect experience of TENS. This prior knowledge may have had an influence on their expectations of TENS and thus partially explain their positive perspective.

[P3] my friend, she bought one, they told her it was a frozen shoulder, she bought one out of the chemist and was using it for about three weeks and she said, perfect, it worked perfect for her. She saw that one likes and the one she got was a lot smaller and she used it for 15 min in the morning and 15 min at night, shoulder is gone. She has had these injections and that and they didn't do anything for her, so I mean, it must be good isn't it?

Another participant who also reported a positive experience of using TENS also had a similar prior knowledge of TENS. They seem to discuss positive expectations of the effect of TENS. Even though they thought that their friend had a different type of machine, they realised that it works in a similar way and therefore the effects are attributed to TENS.

[P1] (interview) I met a friend, a girl on the golf course and she, somebody had told me she had a TENS machine and I spoke to her and she has got some Japanese, I can't remember what it is called but she found it on the internet and she must be the same sort of thing as the Japanese one, probably a wee bit more sophisticated than the TENS machine because I think she said she paid £70 for it but it has obviously got pads and she uses it for her back and she has found it good

Overall, experience and expectations of the intervention seem to be important factors in participant perceptions of TENS. Further education about TENS as part of the intervention protocol may have avoided the disappointment experienced by some users by encouraging more appropriate expectations of effects.

Usability

Participants reported some difficulties using the TENS devices. One common issue was the wires leading to the electrodes. They suggested a wireless system, or one that they could just attach to their leg rather than their belt or trousers would be an improvement.

[P1] (interview] I don't think there is any way that I could think to be improved…. just the fact that if it is on your legs, you have got to put the wires up through your trousers and then gets onto your belt so

They also reported slight embarrassment when other people noticed the unit. Nevertheless, this didn't affect them too much as it seems as though the pain is such that they are happy to endure slight embarrassment to achieve some relief.

[P3] even adults were querying what it was. I am willing to try anything.

[P2] that's true; I'd try anything as well whatever might work.

The way the participants reported using TENS varied across the group. In general, they put it on when they knew they were going to be walking for a prolonged period. This was explained either as TENS was not needed for shorter journeys, or that it was too much hassle to put it on and take it off all the time.

[P1] (interview] it means I could walk further if I wanted to. The times I have used it… I use it now only if I am going to be playing 18 holes of golf, I wouldn't put it on if I had to walk down the street to pick something up at the shop it is quite difficult with me

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it is on a slight hill when I am walking home I feel a slight pain but I wouldn't put the TENS machine on to do that

More continuous use was reported in other participants. This seems to be a more efficient approach to use, however there are possible cautions. As participants reported using electrode pads for prolonged periods, it is important that clinicians advise monitoring for skin irritation or breakdown, although no such adverse effects were reported here. No complications such as these were reported by any of the participants in this study however.

[P3] every day, maybe not so much at the weekends but during the week and I didn't put it on today because I was coming here. I would put it on in the morning and take it off at night and when I needed it, I switched it on

Use of TENS was not simple for all participants, but they seemed to attribute it to personal capacity and capability.

[P1] (interview) is it easy to use? I would say for the majority of people - yes but I am one of these technophobes when it comes to any… I find anything like that difficult but that is not to say it is, that is only because of me, I think most folk would find it quite simple.

Another factor that seemed to affect the usability of the device is the feeling of the stimulation. One participant reported that they had a bad experience in the training session where they turned the intensity up too quickly which was unpleasant for a short while. This seems to have affected their use of the device, as they did not want to experience this again. Others however didn't have the same reaction to the sensation.

[P5] the thing about it for me was the tingling in my legs with it. I can't bear it.

[P4] oh I didn't mind that, I enjoyed that, the tingling in your legs, aye it helped.

The participants in the study used TENS in different ways. They were purposively not provided restrictive instructions as one of the objectives of the study was to ascertain how they might use TENS independently. Three of the five participants kept the device on all day and just turned it on whenever it was needed.

[P2] yes, I put it on in the morning and had it on all day.

[P4] I used it three times a week for 3 hours up and down between the bowling green

[P5] no for me, I used it once a week because that's the only time I go walking.

Physical and social functioning

TENS seemed to help increase self-perceived walking ability and this had a direct impact on the psychological wellbeing of participants. Participants reported being able to walk further with the TENS but interestingly, the fact that they didn't need to stop and 'shake their leg' seemed to be more important rather than an increase in distance. This suggests that avoidance of what they feel to be a socially embarrassing situation might be more important than an increase in walking distance.

[P1] (interview) if I didn't have the TENS and this particular course I'm thinking, I could never get round that course without stopping and having to shake my leg and wait a minute which becomes quite embarrassing when you are playing with someone and you are holding them up.

The participants reported walking further and experiencing less pain while doing so. They seem to be able to push themselves further into pain indicating that they are walking further into ischaemia.

[P3] it numbed the pain; you maybe walked a wee bit further. I did notice a couple of times my foot went numb when I had the machine on. Well, that has happened before without the machine, but it seemed to come on a bit earlier.

When using TENS for social activities and hobbies the participants found that it helped them participate more effectively. They didn't report that it took the pain away, but it allowed them to walk further and cope with the pain more effectively.

[P1] (interview) I find I could get round when I am using it. Now this is a golf course that is quite difficult to walk, and I used it, and I did have some pain but certainly nothing like what I would have expected to experience. So, to answer your question I would say that the TENS machine definitely lessens the pain….. whether I could, I can't definitively say that it totally takes the pain away.

Discussion

This study is the first to explore the lived experience of using TENS at home among individuals with PAD and claudication. Through four interrelated themes: Pain, Expectations, Usability, and Physical and social functioning; the findings illuminate both the potential value and the practical challenges of this non-pharmacological approach to pain management in everyday life.

While all participants were able to use TENS independently, their perceived benefit varied considerably. For some, the device offered meaningful relief and enabled greater walking capacity; for others, the experience was underwhelming or inconsistent. Notably, disappointment appeared closely linked to unrealistic expectations, particularly the assumption that TENS would fully eliminate pain. This reinforces the importance of appropriately framing interventions within patient education and clinical communication. Evidence from broader pain management research suggests that expectation and prior therapeutic experience shape both subjective outcomes and engagement with treatment modalities,[50,51] and these dynamics warrant deeper discussion in relation to TENS in PAD.

Participants with prior familiarity with TENS, or who framed their experience within a context of self-management, tended to report more positive outcomes. This observation aligns with literature emphasising the role of personal beliefs, prior exposure, and perceived control in shaping therapeutic engagement. It also underscores the opportunity for healthcare professionals to support patients in making sense of new interventions in ways that are aligned with their values, prior experiences, and readiness for behaviour change. These findings suggest that implementation strategies for TENS must go beyond device provision and incorporate nuanced, person-centred education.

Usability also emerged as a key theme. While TENS was generally well accepted, practical barriers such as the presence of wires, the bulkiness of the device, or initial sensory discomfort limited its convenience for some. These concerns have been noted in previous studies of TENS across other populations,[31,32] and further discussion is warranted regarding how future device design and user training could better accommodate the needs of older adults or those with comorbidities. There may also be value in exploring wearable, wireless, or app-integrated models of delivery, though further research is needed to understand the feasibility and cost-effectiveness of such approaches.

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In relation to the broader evidence base, it is important to acknowledge the longstanding debate surrounding the clinical efficacy of TENS. While meta-analyses and Cochrane reviews[23,52] have raised concerns regarding the methodological quality and heterogeneity of studies in both acute and chronic pain, these critiques often overlook the implementation dimension. In this study, the mixed views on TENS reflect both its therapeutic limitations and the contextual factors that shape its use in practice. It may be timely for the field to consider how acceptability, usability, and real-world application are integrated into assessments of effectiveness, particularly in complex conditions like PAD where multimorbidity, motivation, and self-management capacity play significant roles.

Importantly, some participants described psychological or social gains, such as a greater sense of control or reduced embarrassment while walking, even when physical improvements were modest. These experiences suggest that the impact of TENS may not be adequately captured by traditional clinical outcomes alone. As such, the integration of qualitative insight alongside quantitative metrics may be essential in capturing the full value of interventions for people with PAD and claudication. Further discussion is needed on how such outcomes are conceptualised and evaluated within rehabilitation and implementation studies.

Taken together, these findings support the need for a more individualised approach to the use of TENS in PAD. Clinically, TENS may be considered as an adjunct to support some patients with PAD who experience claudication pain, particularly where pain is a barrier to walking. However, careful patient education is essential to set realistic expectations, clarify that TENS does not eliminate pain, and provide guidance on device usability and skin monitoring. Future research should explore whether stratified or adaptive approaches to TENS prescription could enhance effectiveness and uptake. Comparative work examining standardised versus tailored intervention protocols would be particularly useful here.

Strengths and limitations

This study contributes novel insights into the lived experience of using TENS among individuals with PAD and claudication, using a qualitative design to foreground patient voice and contextual factors. A particular strength lies in the use of both a focus group and a follow-up semi-structured interview, which together allowed for the expression of a broad range of perspectives. This approach facilitated the emergence of both common and divergent experiences, enriching the interpretive depth of the analysis. The credibility of the findings was further strengthened by the clinical and methodological expertise of the lead researcher, whose background in pain management enabled sensitive and informed facilitation and analysis.

This study has several limitations. The small, convenience sample and single focus group design limit transferability, and thematic saturation was not achieved. One interview was conducted by telephone, which may have altered group dynamics, although data were integrated consistently.

Researcher bias is a limitation as the lead investigator had prior experience with TENS interventions. Steps were taken to mitigate this, including reflexive journaling, dual coding, and independent peer review of analysis. Additionally, the small and relatively homogeneous sample, drawn from a previous clinical study of TENS, constrains the transferability of findings. Participants were predominantly older adults with some prior exposure to TENS, and their decision to participate in this follow-up study may have been shaped by earlier, potentially favourable experiences. It is therefore possible that the sample reflects individuals already predisposed to engage with TENS, while those who found the intervention less helpful or acceptable may have declined to take part. This introduces the potential for selection bias and limits the diversity of perspectives captured, particularly with respect to ethnicity, age, and previous experience of pain management technologies.

The qualitative design, while appropriate for exploring acceptability, cannot determine the prevalence or magnitude of effect, nor can it isolate the specific therapeutic contributions of TENS from contextual or non-specific influences. Additionally, this study relied on a single model of TENS device, and some usability concerns may reflect the limitations of that particular unit rather than the wider category of TENS technologies. Future research could usefully explore the acceptability of newer, wireless or wearable devices and investigate how targeted education or training may mitigate usability challenges, especially in older populations or those with reduced technological confidence.

Finally, the duration of TENS use in this study was limited to four weeks. As such, the findings do not offer insights into longer-term adherence, potential habituation effects, or sustained functional benefits. Longitudinal studies, combining qualitative follow-up with objective measures of use and physical activity, are needed to understand whether TENS can support ongoing behavioural change or symptom management over time.

Future investigations should seek to build on this study by employing purposive sampling strategies to include a broader cross-section of individuals with PAD and claudication, particularly those with limited prior exposure to TENS, and by adopting mixed-methods approaches that can explore both the subjective experience and measurable outcomes of home-based TENS use. In doing so, we can develop a more complete understanding of how this intervention might be integrated into routine vascular care and tailored to support diverse patient needs.

Conclusions

This study is the first to explore how individuals with PAD and claudication experience using TENS at home, offering new insight into its perceived benefits, limitations, and practical challenges. While TENS was generally acceptable and easy to use, its value was shaped by personal expectations, prior experience, and usability in daily life.

These findings highlight the importance of person-centred education and support in the implementation of self-managed interventions. For vascular nurses, this underscores the need to tailor guidance and set realistic expectations. Further research should explore how TENS can be optimised for diverse users and integrated into routine care as part of a broader strategy to support mobility and quality of life in PAD.

Acknowledgements

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of competing interest

The authors declare no conflicts of interest.

CRediT authorship contribution statement

Chris Seenan: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Stephanie Hill:** Writing

– review & editing, Formal analysis. **Ukachukwu Abaraogu:** Writing – review & editing. **Stephen McSwiggan:** Writing – review & editing, Supervision. **Patricia A Roche:** Writing – review & editing, Supervision, Conceptualization. **Chee-Wee Tan:** Writing – review & editing, Supervision. **Tom Mercer:** Writing – review & editing, Supervision, Conceptualization. **Jill Belch:** Writing – review & editing, Supervision, Conceptualization.

References

1. Song P, Rudan D, Zhu Y, Fowkes FJI, Rahimi K, Fowkes FGR, et al. Global, regional, and national prevalence and risk factors for peripheral artery disease in 2015: an updated systematic review and analysis. *Lancet Glob Heal*. 2019;7(8):e1020–e1030.
2. Gornik HL, Aronow HD, Goodney PP, Arya S, Brewster LP, Byrd L, et al. 2024 ACC/AHA/AACVPR/APMA/ABC/SCAI/SVM/SVN/SVS/SIR/VESS Guideline for the management of lower extremity peripheral artery Disease: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Circulation*. 2024;149(24):e1313–e1410.
3. Norgren L, Hiatt WR, Dormandy JA, Nehler MR, Harris KA, Fowkes FGR, et al. Inter-Society Consensus for the management of peripheral arterial disease (TASC II). *J Vasc Surg*. 2007;45(1):S5–67.
4. Treat-Jacobson D, McDermott MM, Bronas UG, Campia U, Collins TC, Criqui MH, et al. Optimal exercise programs for patients with peripheral artery disease: a scientific statement from the American Heart Association. *Circulation*. 2018;139(4):e10–e33.
5. McDermott MM, Greenland P, Liu K, Guralnik JM, Criqui MH, Dolan NC, et al. Leg symptoms in peripheral arterial disease: associated clinical characteristics and functional impairment. *JAMA*. 2001;286(13):1599–1606.
6. McDermott MM, Liu K, Greenland P, Guralnik JM, Criqui MH, Chan C, et al. Functional decline in peripheral arterial disease: associations with the ankle brachial index and leg symptoms. *JAMA*. 2004;292(4):453–461.
7. Gardner AW, Skinner JS, Cantwell BW, Smith LK. Progressive vs single-stage treadmill tests for evaluation of claudication. *Med Sci Sports Exerc*. 1991;23(4):402.
8. Heikkilä K, Coughlin PA, Pentti J, Kivimäki M, Halonen JI. Physical activity and peripheral artery disease: two prospective cohort studies and a systematic review. *Atherosclerosis*. 2019;286:114–120.
9. Sieminski DJ, Gardner AW. The relationship between free-living daily physical activity and the severity of peripheral arterial occlusive disease. *Vasc Med*. 1997;2(4):286–291.
10. Gardner AW, Montgomery PS, Parker DE. Physical activity is a predictor of all-cause mortality in patients with intermittent claudication. *J Vasc Surg*. 2008;47(1):117–122.
11. Schiattarella GG, Perrino C, Magliulo F, Carbone A, Bruno AG, Paulis MD, et al. Physical activity in the prevention of peripheral artery disease in the elderly. *Front Physiol*. 2014;5:12.
12. . *NICE. Peripheral arterial disease: diagnosis and management | guidance | NICE [Internet]* [cited 2023 June 20]. Available from https://www.nice.org.uk/guidance/cg147.
13. Members WC, Gerhard-Herman MD, Gornik HL, Barrett C, Barshes NR, Corriere MA, et al. 2016 AHA/ACC guideline on the management of patients with lower extremity peripheral artery disease. *Circulation*. 2017;135(12):e686–e725.
14. Harwood A, Smith G, Broadbent E, Cayton T, Carradice D, Chetter I. Access to supervised exercise services for peripheral vascular disease patients. *Bull R Coll Surg Engl*. 2017;99(6):207–211.
15. Harwood AE, Pymer S, Ibeggazene S, Ingle L, Caldow E, Birkett ST. Provision of exercise services in patients with peripheral artery disease in the United Kingdom. *Vascular*. 2022;30(5):874–881.
16. Dua A, Gologorsky R, Savage D, Rens N, Gandhi N, Brooke B, et al. National assessment of availability, awareness, and utilization of supervised exercise therapy for peripheral artery disease patients with intermittent claudication. *J Vasc Surg*. 2020;71(5):1702–1707.
17. Lanzi S, Belch J, Brodmann M, Madaric J, Bura-Riviere A, Visonà A, et al. Supervised exercise training in patients with lower extremity peripheral artery disease: a European overview. *Vasa*. 2022;51(5):267–274.
18. Gupta T, Manning P, Kolte D, Smolderen KG, Stone N, Henry JG, et al. Exercise therapy referral and participation in patients with peripheral artery disease: insights from the PORTRAIT registry. *Vasc Med*. 2021;26(6):654–656.
19. Abaraogu UO, Abaraogu OD, Dall PM, Tew G, Stuart W, Brittenden J, et al. Exercise therapy in routine management of peripheral arterial disease and intermittent claudication: a scoping review. *Ther Adv Cardiovasc Dis*. 2020;14:1753944720924270.
20. Abaraogu UO, Ezenwankwo EF, Dall PM, Seenan CA. Living a burdensome and demanding life: a qualitative systematic review of the patients experiences of peripheral arterial disease. *PLoS ONE*. 2018;13(11):e0207456.
21. Abaraogu U, Ezenwankwo E, Dall P, Tew G, Stuart W, Brittenden J, et al. Barriers and enablers to walking in individuals with intermittent claudication: a systematic review to conceptualize a relevant and patient-centered program. *PLoS ONE*. 2018;13(7):e0201095.
22. Barbosa JP, Farah BQ, Chehuen M, Cucato GG, Júnior JCF, Wolosker N, et al. Barriers to physical activity in patients with intermittent claudication. *Int J Behav Med*. 2015;22(1):70–76.
23. Gibson W, Wand BM, Meads C, Catley MJ, O'Connell NE. Transcutaneous electrical nerve stimulation (TENS) for chronic pain - an overview of Cochrane Reviews. *Cochrane Database Syst Rev*. 2019;2019(4):CD011890.
24. Seenan C, McSwiggan S, Roche PA, Tan CW, Mercer T, Belch JJF. Transcutaneous electrical nerve stimulation improves walking performance in patients with intermittent claudication. *J Cardiovasc Nurs*. 2016;31(4):323–330.
25. Seenan C, Roche PA, Tan CW, Mercer T. Modification of experimental, lower limb ischemic pain with transcutaneous electrical nerve stimulation. *Clin J Pain*. 2012;28(8):693–699.
26. Labrunée M, Boned A, Granger R, Bousquet M, Jordan C, Richard L, et al. Improved walking claudication distance with transcutaneous electrical nerve stimulation. *Am J Phys Med Rehabilitation*. 2015;94(11):941–949.
27. Sekhon M, Cartwright M, Francis JJ. Acceptability of healthcare interventions: an overview of reviews and development of a theoretical framework. *BMC Heal Serv Res*. 2017;17(1):88.
28. Holmes MNG, Weinman JA, Bearne LM. You can't walk with cramp!' A qualitative exploration of individuals' beliefs and experiences of walking as treatment for intermittent claudication. *J Heal Psychol*. 2017;22(2):255–265.
29. Harwood AE, Broadbent E, Totty JP, Smith GE, Chetter IC. Intermittent claudication a real pain in the calf"—Patient experience of diagnosis and treatment with a supervised exercise program. *J Vasc Nurs*. 2017;35(3):131–135.
30. Wann-Hansson C, Wennick A. How do patients with peripheral arterial disease communicate their knowledge about their illness and treatments? A qualitative descriptive study. *BMC Nurs*. 2016;15(1):29.
31. Gladwell PW, Badlan K, Cramp F, Palmer S. Direct and indirect benefits reported by users of transcutaneous electrical nerve stimulation for chronic musculoskeletal pain: qualitative exploration using patient interviews. *Phys Ther*. 2015;95(11):1518–1528.
32. Gladwell PW, Badlan K, Cramp F, Palmer S. Problems, solutions, and strategies reported by users of transcutaneous electrical nerve stimulation for chronic musculoskeletal pain: qualitative exploration using patient interviews. *Phys Ther*. 2016;96(7):1039–1048.
33. Barbour RS. *Doing Focus Groups*. 2nd edition. London: SAGE Publications Ltd; 2018.
34. Bowen DJ, Kreuter M, Spring B, Cofta-Woerpel L, Linnan L, Weiner D, et al. How we design feasibility studies. *Am J Prev Med*. 2009;36(5):452–457.
35. O"Cathain A, Croot L, Duncan E, Rousseau N, Sworn K, Turner KM, et al. Guidance on how to develop complex interventions to improve health and healthcare. *BMJ Open*. 2019;9(8):e029954.
36. Sumner J, Ng CWT, Teo KEL, Peh ALT, Lim YW. Co-designing care for multimorbidity: a systematic review. *BMC Med*. 2024;22(1):58.
37. McDermott MM, Liu K, Guralnik JM, Martin GJ, Criqui MH, Greenland P. Measurement of walking endurance and walking velocity with questionnaire: validation of the walking impairment questionnaire in men and women with peripheral arterial disease. *J Vasc Surg*. 1998;28(6):1072–1081.
38. Nicholas MK. The pain self-efficacy questionnaire: taking pain into account. *Eur J Pain*. 2007;11(2):153–163.
39. Sullivan MJL, Bishop SR, Pivik J. The pain catastrophizing scale: development and validation. *Psychol Assess*. 1995;7(4):524–532.
40. Miller RP, Kori SH, Todd DD. The Tampa scale. *Clin J Pain*. 1991;7(1):51.
41. CRAIG CL, MARSHALL AL, SJÖSTRÖM M, BAUMAN AE, BOOTH ML, AINSWORTH BE, et al. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc*. 2003;35(8):1381–1395.
42. Morgan MBF, Crayford T, Murrin B, Fraser SCA. Developing the Vascular Quality of Life Questionnaire: a new disease-specific quality of life measure for use in lower limb ischemia. *J Vasc Surg*. 2001;33(4):679–687.
43. Dworkin RH, Turk DC, Farrar JT, Haythornthwaite JA, Jensen MP, Katz NP, et al. Core outcome measures for chronic pain clinical trials: IMMPACT recommendations. *Pain*. 2005;113(1–2):9–19.
44. Morgan D. Focus Groups as qualitative research. 1997;
45. Wilkinson S. Focus Groups in Health research. *J Heal Psychol*. 1998;3(3):329–348.
46. Krueger RA, Casey MAnne. *Focus groups : a Practical Guide For Applied Research*. Fifth edition. Thousand Oaks, California: SAGE; 2015.
47. Nowell LS, Norris JM, White DE. Moules NJ. Thematic analysis. *Int J Qual Methods*. 2017;16(1):1609406917733847.
48. QSR-International. NVivo (Version 12) [Internet]. Melbourne: lumivero; 2018. Available from: https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home
49. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *Int J Qual Heal Care*. 2007;19(6):349–357.
50. Colloca L, Akintola T, Haycock NR, Blasini M, Thomas S, Phillips J, et al. Prior therapeutic experiences, not expectation ratings, predict placebo effects: an experimental study in chronic pain and healthy participants. *Psychother Psychosom*. 2020;89(6):371–378.
51. Charron J, Rainville P, Marchand S. Direct comparison of placebo effects on clinical and experimental pain. *Clin J Pain*. 2006;22(2):204–211.
52. Johnson MI, Paley CA, Howe TE, Sluka KA. Transcutaneous electrical nerve stimulation for acute pain. *Cochrane Database Syst Rev*. 2015;2021(6):CD006142.

Please cite this article as: C. Seenan, S. Hill, U. Abaraogu et al., Exploring patients' experiences of using Transcutaneous Electrical Nerve Stimulation for Claudication, Journal of Vascular Nursing, https://doi.org/10.1016/j.jvn.2025.11.004