

Non-invasive Peripheral Neurostimulation for Pain Management and Rehabilitation of War-related Injuries: One-year Data from Ukraine

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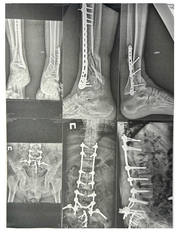
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BACKGROUND

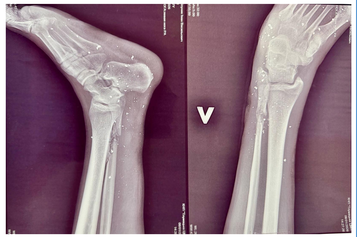
The armed conflict in Ukraine has produced a high incidence of catastrophic extremity trauma from blast, shrapnel and high-velocity ballistic mechanisms, frequently necessitating limb amputation. Resultant residual limb, phantom and neuropathic pain compromise prosthetic rehabilitation and long-term quality of life. Under prevailing wartime constraints, access to radiofrequency ablation and implantable neuromodulation is limited, while systemic analgesics carry unfavourable adverse-effects and a risk of dependence. Non-invasive peripheral neurostimulation therefore represents a plausible therapeutic alternative warranting evaluation.









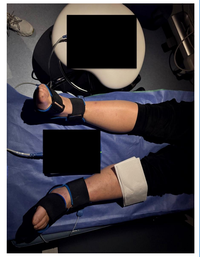


MATERIALS AND METHODS

Ethical approval was granted by the institutional Ethics Committee on 06.06.2025 and we are presenting the data from our ongoing prospective case series. 398 patients with heterogeneous painful conditions, predominantly post-amputation states and traumatic nerve injuries who attended the clinic since 08.06.2025 were selected for non-invasive peripheral neurostimulation. Each received a single 30-minute treatment with a patented high-frequency neurostimulation device, delivered as peripheral nerve stimulation or peripheral field stimulation via surface electrode pads or custom electrode wraps. Stimulation was confirmed subjectively over the painful territory and titrated to the maximum tolerable intensity, with abolition of baseline pain perception as the endpoint. Pain scores were recorded at baseline, immediately post-treatment, at 24 and 48 hours. Patients residing remotely were offered domiciliary therapy with a take-home device to sustain analgesia and support rehabilitation. Longitudinal follow-up was conducted monthly via telephone until sustained analgesia was achieved; participants were advised to contact the clinic for additional support or treatments as needed. The study aimed to evaluate the immediate and short-term analgesic effects and functional outcomes associated with non-invasive peripheral neurostimulation in individuals with amputations or nerve injuries related to battlefield injuries. Long-term follow-up comprised monthly telephone review until sustained analgesia was reported, with open access for further treatment. The follow-up is ongoing and the first cohort of patients have completed an year and is part of an ongoing prospective study.





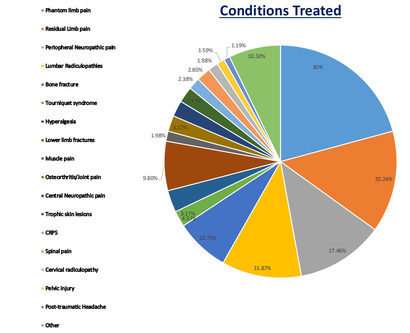


RESULTS

267 of the 398 treated patients had sustained battlefield trauma, of whom 160 had undergone traumatic limb amputation, including bilateral lower-limb and upper-limb amputations. Nearly 45% of the injuries were due to drone strikes, landmine and missile blasts, while gunshot injuries accounted for over 7%. 20% of patients had pain in the lower back and had sustained falls. The stimulation procedure was universally well tolerated, although a subset required higher stimulation intensities before perceiving the stimulus over the painful region. Baseline pain scores, mobilisation difficulties and additional quality-of-life parameters were compared with post-treatment values. Mean visual analogue scale (VAS) score fell from 6.73 at baseline to 2.98 immediately following treatment. At 24 and 48 hours, mean VAS scores were maintained at 4.63 and 3.76 respectively, indicating persistence of analgesic benefit beyond the treatment session. The mean duration of clinically meaningful pain relief was 10.96 hours. The majority of amputees reported substantial attenuation of phantom-limb pain after a single treatment, accompanied by subjectively improved ease of ambulation and prosthetic use. Further data analysis demonstrated a reduction in analgesic medication consumption and objective improvement in prosthetic mobility. The initial cohort had been followed up for a year, and data collection is continuing. Repeat treatment was in 35%. All participants tolerated the stimulation procedure well. A subset required higher stimulation intensities to achieve perceptual and/or therapeutic effects. Intensity was adjusted as per patient preference.

Etiology of Pain Syndrome

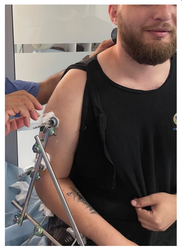
- Blast-missile injury – 29.36%
- Landmine injury – 15.87%
- Fall – 9.52%
- Back pain – 9.13%
- Gunshot (missile-type) wound – 7.14%
- Exacerbation of pre-existing condition – 4.37%
- Diabetes mellitus – 3.97%
- Motor vehicle collision – 3.57%
- Cervical spine issues – 1.98%
- Back pain (recurrent) – 1.59%
- Heavy body armor – 1.59%
- Joint problems – 1.59%
- Surgical intervention – 1.19%
- Cumulative trauma – 0.79%
- Hip replacement – 0.79%
- Shrapnel wound – 0.79%
- Trigeminal nerve neuropathy – 1.59%
- Other (rheumatoid arthritis) – 2.8%



DISCUSSION

War-related pain syndromes remain undertreated in many settings. Contributing factors include limited healthcare resources, scarcity of specialist expertise, supply chain disruptions and ongoing hostilities. These barriers delay rehabilitation and mobilisation, exacerbate mood disturbances and sustain severe persistent pain. Early integration of non-invasive peripheral neurostimulation into post-amputation and broader neuropathic pain pathways may mitigate these challenges. It offers a non-pharmacological option that can be deployed at the point of care and in remote or low-resource environments. The patented therapy alternates two high-frequency carriers between two independent electrodes. As these carriers traverse skin and deep tissues, tissue polarisation and the nonlinear electrodynamics of neuronal and muscular structures generate intermodulation products. These include lower-frequency components that effectively produce a low-frequency field beneath each electrode. This interaction zone forms a hemispherical region approximately three inches in diameter that encompasses local nociceptive pathways, potentially modulating axonal excitability and synaptic transmission. The proposed mechanism is field-based interference with nociceptive signal propagation, which reduces peripheral nociceptive input to the central nervous system.Of 398 treated patients, 267 had sustained battlefield trauma. Most were military personnel injured during the ongoing Ukraine–Russia conflict. Of these, 160 had undergone traumatic limb amputation, including bilateral lower-limb and upper-limb amputations. Nearly 45% of injuries resulted from drone strikes, landmines and missile blasts, while gunshot wounds accounted for over 7%. A further 20% of patients presented with lower back pain following falls. The procedure was universally well tolerated, although a subset required higher stimulation intensities before perceiving the stimulus over the painful region. Baseline pain scores, mobilisation difficulties and quality-of-life parameters were compared with post-treatment values. Mean VAS score fell from 6.73 at baseline to 2.98 immediately after treatment. It remained at 4.63 at 24 hours and 3.76 at 48 hours, indicating that the analgesic benefit persisted beyond the treatment session. The mean duration of clinically meaningful pain relief was 10.96 hours. Most amputees reported substantial attenuation of phantom-limb pain after a single treatment, with subjectively easier ambulation and prosthetic use. Further analysis demonstrated reduced analgesic consumption and objective improvement in prosthetic mobility. The initial cohort has been followed up for one year, and data collection is ongoing. Early intervention is being implemented to reduce comorbidity burden and support mental health and overall well-being. Plans include expanding the service to additional centres across Ukraine and training health professionals to deliver treatment.





CONCLUSIONS

Although battlefield injuries, including traumatic amputation, typically receive prompt surgical management, post-amputation and other neuropathic pain syndromes remain undertreated owing to resource limitations, scarcity of specialist expertise, supply chain disruptions and ongoing hostilities. The consequences include delayed rehabilitation and mobilisation, depressed mood and avoidable suffering from severe persistent pain. We therefore advocate incorporating non-invasive peripheral neurostimulation into the early management pathway for post-amputation and neuropathic pain. Extended over a one-year period, repeated sessions as required over a period of 12 months provided sustained cumulative analgesia, reducing reliance on opioid and neuropathic pain medications and enabling successful rehabilitation. Durable pain control may support uninterrupted rehabilitation, earlier and more consistent prosthetic use, improved mobility and greater functional independence. Secondary benefits may include improved mood, sleep and overall quality of life, together with reduced healthcare utilisation and medication costs. Deployable at the point of care and in remote or low-resource environments, this cost-effective, sustainable and readily scalable modality carries minimal adverse-effect burden.

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Contact

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