

Management of Battlefield Trauma Pain with Non-invasive Peripheral Neurostimulation:

Case series from Two Centres in Ukraine

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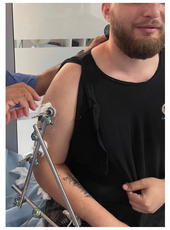
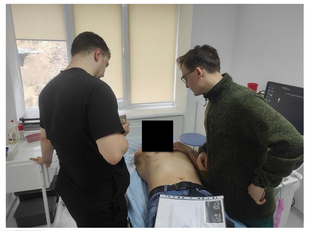
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Clinical Hospital

BACKGROUND

Non-invasive peripheral neurostimulation as a target-specific, non-pharmacological strategy to attenuate post-traumatic neuropathic pain including post-amputation pain syndromes due to complex battlefield trauma was commenced at a centre in Ivano-Frankivsk, Ukraine since June 2025. Since June 2026, a second centre in Lviv which is the largest rehabilitation unit in Ukraine started using the same protocol. Though both centres were treating battlefield injuries, the patient cohorts were slightly different; the Ivano-Frankivsk site had early surgical treatments whilst the Lviv centre was the largest rehabilitation unit in Ukraine with patient undergoing extensive rehabilitation within the Unbroken centre. We are analysing the pooled data herewith.

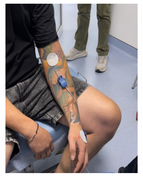



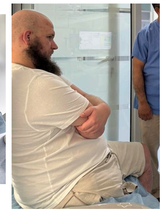




MATERIALS AND METHODS

Ethical clearance was formally granted on 06 June 2025 (Ivano-Frankivsk) and 30 June 2026 (Lviv). Data from a total cohort of 517 patients (398 from Ivano-Frankivsk over 12 months and 119 from Lviv over 2 months) were reviewed. All subjects had undergone 30-minute therapeutic sessions utilizing a high-frequency neurostimulation device, delivered as targeted peripheral nerve stimulation (PNS) or peripheral field stimulation (PFS) via dedicated hydrogel electrodes or circumferential limb 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. Functional prosthetic mobilization and biomechanical ease of movement were secondary endpoints. Patients residing in remote geographic locations were provisioned with portable neurostimulation units for self-administration, with longitudinal progress monitored via structured monthly telephone assessments. 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 in individuals with amputations or nerve injuries related to battlefield injuries following non-invasive neurostimulation.



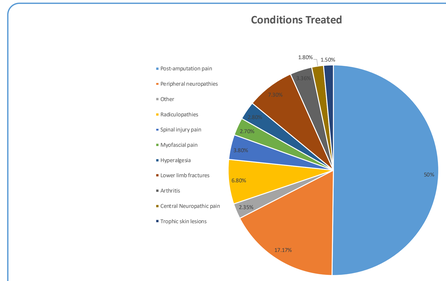


RESULTS

91.6% sustained battle-related injuries with half of them due to blast/missile injuries and landmine explosions, with gunshot injuries being the third commonest cause.
Total patients in the study population: 517
Injured: 474 sustained battlefield injuries
Amputation subgroup: 259 patients with traumatic limb amputations, including bilateral lower-limb amputations and upper-limb amputations (22 subjects)
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.
Baseline pain (visual analog scale, VAS) prior to treatment: mean 6.65 (6.73/6.4)
Immediately post-treatment: mean 2.67 (2.98/1.61)
Short-term follow-up VAS: 24 hours: mean 4.23 (4.63/2.91)
Short-term follow-up VAS: 48 hours: mean 3.68 (3.76/3.43)
Mean duration of meaningful pain relief: 11.29 (10.96/12.4) hours
Repeat treatments: 84% patients underwent repeat stimulation sessions, with effects comparable to the initial treatment.

All subjects from both sites did not report any adverse events due to the stimulation protocol. Higher stimulation thresholds were required in a subset of patients on both sites. Among amputees, a substantial reduction in phantom-limb pain was observed after the initial treatment. Improved mobilisation with prosthetic devices was reported following treatment. The patient groups were different with the Lviv site predominantly had subjects with post-amputation pain, a cohort that gave better improvement in pain scores also at the Ivano-Frankivsk site. Ivano-Frankivsk site was also dealing with long-term patients with challenging pain problems over a year; we are continuing the follow up of long-term data from Lviv site for a true comparison. Data collection is ongoing at both sites.

The intervention demonstrated immediate and short-term reductions in pain with a trend toward increased functional accessibility for prosthetic-assisted mobilisation in amputees and reduced analgesic use. This data is being collected as part of the long-term follow up.

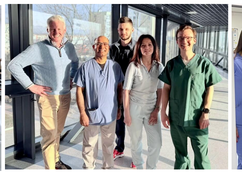


DISCUSSION

The patented electrical stimulation therapy modulates cutaneous electrical delivery by alternating two high-frequency carriers between two independent electrodes. As these HF carriers traverse skin and deep tissues, tissue polarization and nonlinear electrodynamics of neuronal and muscular structures generate intermodulation products. The resulting spectrum includes lower-frequency components arising from nonlinear mixing, effectively producing a low frequency (LF) field beneath each electrode. Conceptually, the interaction zone forms a hemispherical region (~3 inches in diameter) that encompasses local nociceptive pathways, potentially modulating axonal excitability and synaptic transmission. The proposed mechanism suggests a electrical field-based interference with nociceptive signal propagation, producing analgesia by reducing peripheral nociceptive input to the central nervous system.

High-frequency non-invasive neurostimulation at two separate sites have demonstrated significant clinical utility as a safe and easy to use non-pharmacological, cost-effective modality, facilitating opioid-sparing analgesia and improved functional outcomes. Post-amputation pain management seems to have better outcomes as compared to other traumatic nerve injuries. Lessons learnt from the initial site and the relevant expertise have resulted in improved outcomes at the second site and this is encouraging to start further treatment sites across Ukraine. We have identified three separate stages in the journey of these patients – acute trauma and initial stabilisation and then transfer to facilitate surgery including amputation or refashioning of the stump as well as fixation of long bone fractures, wound debridement and reconstructive surgery where peripheral stimulation was used for acute pain management. The third stage where we supported most of the cohort were in the rehabilitation phase when they were being offered limb prostheses as well as going through extensive physiotherapy for muscle and nerve injury.

This cohort comprises predominantly military personnel sustaining shrapnel injuries from drone strikes, artillery shelling, and high-velocity gunshot trauma amid the ongoing Ukraine–Russia conflict. We are implementing early intervention to mitigate comorbidity burden and bolster mental health and overall well-being. Plans include expanding the service to additional centres across Ukraine and training health professionals in the delivery of non-invasive neurostimulation The objective is to monitor progress with a focus on improved mobility, durable pain relief, and reduction and/or tapering of opioid and neuropathic pain medications. We also intend to compare outcomes with analogous studies in veterans from other countries and to explore applicability to civilians undergoing amputations for peripheral vascular disease or diabetes as well as traumatic amputations.


CONCLUSIONS

In conclusion, high-frequency non-invasive neurostimulation has demonstrated significant clinical utility in managing post-amputation and other neuropathic pain resulting from battlefield injuries in Ukraine. Although such injuries typically receive prompt initial care, chronic neuropathic pain often remains undertreated due to limited healthcare resources, gaps in specialist expertise, supply chain disruptions, and the ongoing conflict. These barriers delay rehabilitation, compromise mobilization, exacerbate mood disturbances, and sustain chronic pain. Implementation at two separate sites has shown this modality to be safe, easy to use, cost-effective, and non-pharmacological, facilitating opioid-sparing analgesia and improved functional outcomes. Notably, post-amputation pain responded more favourably than other traumatic nerve injuries. Lessons learned and expertise developed at the initial site translated into improved outcomes at the second, demonstrating the value of shared knowledge and refined clinical practice. Early integration of non-invasive peripheral neurostimulation into post-amputation and broader neuropathic pain protocols may help overcome these persistent challenges. Deployable at the point of care and particularly in remote or low-resource environments, it offers rapid analgesic benefit, reduced medication burden, and minimal adverse effects. Its cost-effectiveness, scalability, and sustainability support continued engagement in rehabilitation and meaningful quality-of-life improvements. These encouraging results provide a strong rationale for establishing further treatment sites across Ukraine.

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Contact

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