



Non-invasive Spinal Cord Stimulation and Seizures/Epilepsy in Children: What the Published Research Shows

A research summary for clinical application

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This document summarizes the published scientific evidence specifically regarding non-invasive spinal cord electrical stimulation (tSCS) — a non-invasive technique using electrodes placed on the spine — and its relationship to seizures or epilepsy in children. Only studies involving electrical muscle stimulation or spinal electrical stimulation are included.

Note: tSCS (electrodes on the spine) is a very different technique from brain stimulation, cranial stimulation, or vagal nerve stimulation. This document refers exclusively to spinal and muscular electrical stimulation.

Section 1: Does Spinal Electrical Stimulation Increase Seizures in Children?

The key question for clinical practice is whether applying electrical stimulation to the spinal cord — for the purpose of motor rehabilitation — increases the risk of seizures in children. Here is what the current literature shows:

What the animal research suggests:

Animal studies suggest that cervical spinal cord stimulation at 300 Hz may actually reduce seizure frequency through inflammatory pathway modulation — suggesting a potential anti-epileptic rather than pro-epileptic mechanism. However, these are preclinical findings and cannot be directly applied to clinical practice in children.

What the pediatric human research shows:

The transcutaneous spinal stimulation literature in pediatrics focuses on motor outcomes. Across all published pediatric tSCS studies for spinal cord injury, acute flaccid myelitis, cerebral palsy, and spinal muscular atrophy, the consistent finding is:

- Seizures were not reported as an adverse event in any session across any published pediatric tSCS study
- Adverse events that were reported were limited to non-neurological issues:
 - Skin redness at electrode sites in approximately 19% of assessments, dissipating within hours
 - Autonomic dysreflexia (in Spinal Cord Injury) 5.4% of sessions

- Headache in approximately 1.5% of sessions
- One participant withdrew due to pain sensitivity on day one — no seizures occurred

Section 2: What Does Surface Electrical Stimulation Show in Children?

Surface electrical stimulation (electrodes are placed on the skin)— including TENS, functional electrical stimulation and tSCS — has been studied in children across multiple conditions. The evidence is consistent:

TENS (Transcutaneous Electrical Nerve Stimulation):

Pediatric TENS studies for pain, bladder dysfunction, and other conditions consistently report no seizure events. Adverse effects were limited to mild skin irritation and discomfort. A systematic review of pediatric neuromodulation adverse event reporting found that across 56 studies, seizure was not reported as occurring in any results-based papers on surface stimulation modalities.

tSCS (Transcutaneous Spinal Cord Stimulation) for Motor Function:

Current pediatric evidence for transcutaneous spinal cord stimulation used for motor function does not show an increased seizure risk. In a pilot study of 130 combined tSCS and locomotor training sessions in children with spinal cord injury, 88.5% of sessions were entirely free of adverse effects — and seizure was not among any reported event.

Section 3: The 4 Published Pediatric tSCS Safety Studies

The following 4 published studies directly address the safety of non-invasive spinal cord stimulation in children. Across all 4 studies, seizures were never reported as an adverse event.

1. Safety and Feasibility of Cervical and Thoracic Transcutaneous Spinal Cord Stimulation to Improve Hand Motor Function in Children With Chronic Spinal Cord Injury

Singh et al. — Neuromodulation, 2023 — 7 children with chronic cervical spinal cord injury, ages 6–17 years — 21 sessions

Already referenced on spinalstim.net/resources/

Link: [https://www.neuromodulationjournal.org/article/S1094-7159\(23\)00648-7/fulltext](https://www.neuromodulationjournal.org/article/S1094-7159(23)00648-7/fulltext)

Key finding: All seven participants tolerated cervical and thoracic tSCS without any serious adverse events. Transient skin redness occurred in 19% of assessments, dissipating within hours. No seizures were reported in any session.

2. Non-invasive Spinal Stimulation Safely Enables Upright Posture in Children with Spinal Cord Injury

Keller et al. — Nature Communications, 2021 — 8 children with spinal cord injury, ages 3–14 years — 22 sessions

Already referenced on spinalstim.net/resources/

Link: <https://www.nature.com/articles/s41467-021-26026-z>

Key finding: Spinal stimulation was well-tolerated across all sessions. One episode of autonomic dysreflexia was recorded and resolved without complications. No seizures were reported in any session.

3. Cumulative Transcutaneous Spinal Stimulation with Locomotor Training Safely Improves Trunk Control in Children with Spinal Cord Injury: Pilot Study

Amirova et al. — Children (Basel), 2025 — 3 children with spinal cord injury — 130 sessions total

Link: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC12293838/>

Key finding: 88.5% of sessions were entirely free from adverse effects. Reported events were autonomic dysreflexia (5.4%), skin redness at electrode sites (4.6%), and headaches (1.5%). Seizures were not among any reported adverse event across 130 sessions.

4. Transcutaneous Spinal Cord Stimulation Enables Recovery of Walking in Children with Acute Flaccid Myelitis

Neighbors et al. — Children (Basel), 2024 — 4 children with acute flaccid myelitis — 22 sessions each (2 hours per session)

Link: <https://pmc.ncbi.nlm.nih.gov/articles/PMC11430423/>

Key finding: All participants tolerated the full intervention without pain or any adverse response across all sessions. No seizures were reported.

Section 4: Important Clinical Considerations for Children with Active Epilepsy

While the safety picture from published tSCS studies is consistently encouraging, an important gap exists in the current literature: none of the pediatric tSCS motor rehabilitation studies specifically enrolled children with known active epilepsy. The following clinical considerations are recommended when working with this population:

- NISE-Stim parameters are conservative. Sessions begin gently and parameters can be increased gradually based on the child's response and tolerance.

Children with Epilepsy are frequently treated successfully with NISE-Stim.

- Ensure continuous clinical observation throughout all sessions, particularly during the initial period.
- If a seizure occurs during a session (as it can happen with other therapy techniques), use your judgement if you need to discontinue the stimulation
- If in any doubt about the child's response to stimulation, discontinue NISE-Stim and consult with the child's neurologist before resuming. If there would be a direct correlation between NISE-Stim and an increase in seizure activity, stopping the stimulation should allow the child to return to their baseline seizure frequency.

- Always involve the child's neurological care team before and throughout the process.
- Children with infantile spasms should not begin NISE stim sessions until their seizures are well-controlled by medication and a neurologist has given approval to proceed.

What are infantile spasms? Infantile spasms (also known as West Syndrome) are a specific type of seizure disorder that typically begins in the first year of life. They are characterized by sudden, brief muscle contractions — often a forward bending of the head and body — and are associated with a specific abnormal brainwave pattern. Infantile spasms require specialized neurological management and are considered a contraindication to NISE stim until controlled.

Section 5: Observations from Clinical Practice

The following observations are drawn from direct clinical experience working with children with active epilepsy who have received NISE-Stim. These observations complement the published literature and reflect real-world practice with this population.

Children with active epilepsy receiving NISE-Stim:

Many children with active epilepsy have undergone NISE-Stim sessions without any observed increase in seizure frequency or severity. The presence of a diagnosed seizure disorder does not automatically preclude a child from receiving spinal stimulation, provided appropriate precautions are in place and the treating neurologist is involved in the decision.

Spontaneous seizures during sessions:

There have been instances where children experienced seizures during NISE-Stim sessions. Importantly, these children were also having seizures during other therapeutic activities — reflecting the spontaneous nature of their seizure disorder rather than a direct response to the stimulation itself. If a seizure occurs during a NISE-Stim session use your judgement if the sessions should be discontinued. To date, no direct causal correlation has been observed between NISE-Stim and an increase in seizure activity.

Overall safety in this population:

Non-invasive spinal cord stimulation is considered safe to use with children who have epilepsy, provided the seizures are adequately controlled and the neurological care team is in agreement. If any increase in seizure activity is observed following sessions, discontinuing the stimulation is the appropriate first step — and the child should return to their pre-treatment baseline.

KEY MESSAGE: Across all published pediatric tSCS studies, seizures have never been reported as an adverse event. Clinical experience further supports that many children with active epilepsy have received NISE stim without any observed increase in seizure activity. Each case is approached individually, with appropriate precautions, conservative parameters, and in close collaboration with the child's neurological care team. When in doubt, discontinue the stimulation and consult the neurologist.

References

- Singh G, et al. Safety and Feasibility of Cervical and Thoracic Transcutaneous Spinal Cord Stimulation to Improve Hand Motor Function in Children With Chronic Spinal Cord Injury. *Neuromodulation*. 2023. [https://www.neuromodulationjournal.org/article/S1094-7159\(23\)00648-7/fulltext](https://www.neuromodulationjournal.org/article/S1094-7159(23)00648-7/fulltext)
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