Implantable Neurostimulation in Chronic Pain: A Bibliometric Analysis of Trial Output, Design, and Global Distribution

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INTRODUCTION

Spinal cord stimulation (SCS), dorsal root ganglion stimulation (DRG-S), and peripheral nerve stimulation (PNS) are increasingly used for chronic pain. However, the volume, design, and distribution of randomized evidence across these modalities remain incompletely characterized.

AIM

To characterize the volume, design, and geographic distribution of randomized controlled trials across SCS, DRG-S and PNS, with no restriction by publication year.

METHOD

- **PubMed, Embase, Scopus, Web of Science, CENTRAL, and LILACS/SciELO**
- **RCTs of implantable SCS, DRG-S, and PNS for chronic pain**
- **Trial characteristics classified from title and abstract**
- **3,318 records screened**
- **Descriptive and geospatial analysis in R 4.5.3 in Microsoft Visual Studio Code**

*IRB exemption: publicly available, de-identified, aggregated data.
** AI-assisted code generation (Claude, Anthropic) for data cleaning and workflow development under investigator oversight.

MAIN FINDING

SCS accounted for **nearly 80%** of randomized evidence, while **DRG-S and PNS remained sparsely studied. Head-to-head stimulation comparisons were nearly absent**, and trial registration and blinding were infrequently reported

Characteristic	n	%
Modality		
Spinal cord stimulation	175	79.5
Peripheral nerve stimulation	20	9.1
Multiple implantable targets	20	9.1
DRG stimulation	5	2.3
Control condition		
Other / unclear	131	59.5
Conventional medical management / usual care	51	23.2
Sham / placebo stimulation	36	16.4
Active stimulation comparator	2	0.9
Design		
Parallel group	163	74.1
Crossover	57	25.9
Blinding		
Not stated	153	69.5
Double or triple blind	43	19.5
Open label	17	7.7
Single blind	7	3.2
Number of centres		
Single centre or not stated	149	67.7
Multicentre	71	32.3
Trial registration identifier in abstract		
Not reported	188	85.5
Reported	32	14.5

Table 1: Characteristics of included randomized controlled trials (N = 220).

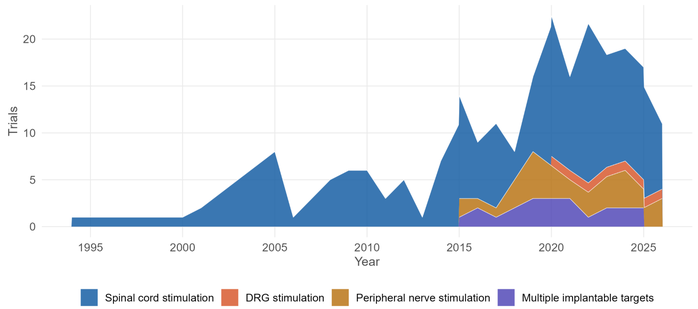


Figure 1: Randomized trials of implantable neurostimulation for chronic pain by modality and year.

220 RCTs included

Spinal Cord Stimulation
175 trials (79.5%)

DRG-S + PNS
11.4%

Registration Identifier Reported
32 trials (14.5%)

Increasing trial output
Peak: **19 trials (2020)**

United States **38.8%**
Netherlands **12.9%**
+50%

KEY RESULTS

- **220 RCTs** met inclusion criteria from **3,318 records**, published from 1994–2026.
- Annual trial output peaked at **19 studies in 2020**.
- **SCS: 175 trials (79.5%)**; PNS: 20 (9.1%); DRG-S: 5 (2.3%); multiple targets: 20 (9.1%).
- Control condition was **unclear in 59.5%**; conventional management was 23.2%, sham 16.4%, and active stimulation comparison only **0.9%**.
- **25.9%** used crossover designs; **19.5%** reported double/triple blinding; **32.3%** were multicenter.
- Trial registration appeared in only **14.5%.**
- **United States (38.8%)** and **Netherlands (12.9%)** accounted for **51.7%** of trials with an identifiable senior-author country

CONCLUSIONS

SCS dominates the randomized evidence for implantable neurostimulation. Despite expanding clinical use**, DRG-S and PNS are supported by few trials, and head-to-head comparisons of stimulation strategies are nearly absent**, and reporting of blinding and trial registration is limited. These gaps identify **key priorities for future randomized research.**

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