SCS IMPLANT IN SINGLE STAGE SKIP THE TRIAL?

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The recommendation that all candidates for SCS should undergo a screening trial prior to permanent SCS implantation is largely based on expert opinion rather than firm evidence.

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Introduction

Since the 1970s, SCS trial has been using a temporary electrode connected to an external pulse generator to mimic long-term treatment and identify subjects who are likely to have a successful response .

Erickson DL. et al .J Neurosurg 1975;43:440–444.
Oakley JC, et al. Neuromodulation 2008;11:66–73.
Kumar K, et al. Neurosurgery 2006;58:481–496.
North RB. Neuromodulation 2003;6:4–5.
Kin K,et al. World Neurosurg 2018;113:e391–e398.

THE IMPORTANCE OF ADEQUATE INFORMATION

- SCS is neither a complete cure for pain nor is it a standalone treatment, there is a continuing need for the individual to engage with coping strategies, and preferably to receive preparation for this beforehand.
- Patient will report discomfort, as well as unusual sensations and depending on the type of device implanted may need to adapt to a regular routine of re-charging the battery. There is a need for personal adjustment to a different way of life, involving effort to manage expectations of the treatment.
- Severe acute pain and length of physical recovery have a significant impact for many participants, contributing to their preference for a one- stage procedure

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The reason for trial

More than 100 billion US dollars are spent every year on chronic back and limb pain, far exceeding the annual costs of heart disease, cancer, or diabetes .

Emerging evidence continues to underscore spinal cord stimulation as an effective intervention for chronic back and limb pain.

With the rise in costs of SCS, there is increasing pressure from third-party payers to demonstrate appropriate allocation of this intervention for the right patient cohort.

One of the major challenges in the field of neuromodulation is the dearth in our understanding of the factors that are predictive of successful trials and eventual conversion to permanent implants.

The reason for trial

A screening trial allows patients :

- to experience the sensation generated by SCS and its interaction with body movements,
- to determine the appropriate lead location,
- to formulate a broad evaluation of the pain relief

A screening trial could provide physicians with an estimate of electrical current consumption required from the device that guides their choice of a relatively expensive SCS implantable pulse generator .

EBM

There is no RCT evidence:

1) to what extent SCS screening trials predict long-term outcome;

2) what trial duration is optimal;

3) whether their added cost (by comparison with single stage implantation) is justified.

EVIDENCE:outcome

Successful SCS screening trial: reporting **at least 50% reduction** in pain from baseline on a pain rating scale, satisfactory on-table paraesthesia coverage (ie, ≥80%) of the pain area or successful location of leads at anatomical target for paraesthesia-free therapies, reduction in pain medications or improved quality of life and function.

Some clinicians do "on table trials," proceeding to implantation in a single stage and reported overall results comparable to those achieved with more prolonged trials.

The most-cited, largest, and longest-term studies have reported overall long-term success rates on the order of **50%** of those receiving SCS implants for chronic use after successful two-stage screening trials, indicating that trials have limited sensitivity.

Oakley reported (2008) that permanent implants had worthwhile long-term results in a small series of subjects whose trials did not reach the threshold for "success", indicating that trial failure does not preclude long term SCS success.

Are Trials really useful?

The initial benefits of the therapy may decrease over time, the so called "Failed SCS Syndrome" (FSCSS), which may lead to explantation of the device (Van Buyten et al. 7.9% per year).

- **Loss of Efficacy (LoE)**, happening for various reasons in patients using paresthesia-based stimulation

- **Loss of pain Coverage (LoC)** related to a new onset of pain or a change in initial pain pattern; despite a stable pain condition there is a no longer perceived paresthesia in residual painful territories, adequately covered by SCS initially. In these cases, when reprogramming remains unsuccessful in "recapturing" the residual painful area, this LoC usually leads to LoE.

- a loss of Efficay (LoE) patients, despite adequate pain coverage (no LoC) may decrease the use of stimulation or determine the abandon of the therapy(a real "tolerance" to the electrical delivery of SCS).

Adapters can be used for these, enabling clinicians to upgrade the IPG with a different stimulation technology, without changing the existing leads. SCS programs and new waveforms can be used to regain pain relief .

EVIDENCE: duration

Demonstration of pain relief with a temporary implant before implantation of a more costly and potentially more risky permanent system was required by Medicare in 1979 as a pre-requisite for reimbursement.

The attendant risk of infection with a screening strategy that requires a percutaneous extension to an external pulse generator has deterred U.S. clinicians from extending the trial beyond approximately one week.

Some payers (e.g., the Belgian health care system, which requires a 30-day trial) require longer screening with a temporary electrode connected to an external PG as a condition for reimbursement.

EVIDENCE: duration

If SCS were a drug, the typical screening trial duration would be weeks, months, to allow for dose titration, management of side effects, and assessment of response.

Novel waveforms should be included in SCS screening trial protocols. Because no single waveform has been shown to be uniformly effective in all patients, and a waveform that is inferior overall in a study population might nevertheless be the most effective choice for select patients, patients considering SCS should ideally be exposed to the multitude of programming parameters.

EVIDENCE: infection

The percutaneous exit of a lead limits screening trial duration, as the external segment is by definition contaminated. The temporary implant , if left in place for a ***"sufficient"*** amount of time which cannot be predicted, will eventually become contaminated and cause infection.

If an infection does not become apparent until after a costly IPG has been implanted, the entire implanted system generally requires removal, interrupting treatment until the infection has been successfully treated and a new system can be implanted. Unfortunately, some subjects never regain successful pain relief after removal of a system due to a complication.

The more costly the second stage of SCS, the higher the screening trial success rate needed to justify the expense of the trial.

EVIDENCE: infection

Guidelines propose that "... under appropriate infection control conditions, the staged trial and completion implant pathway can be utilized in select patients **without a significant increase** in infection rates".

This guideline, despite its apparent goal of reassuring clinicians conducting screening trials, **does not define "significant increase."**

Developing an infection during SCS treatment is a significant event that can forever obviate any real or potential therapeutic benefit provided by SCS

An infection that becomes manifest only after implantation of a complete system, determining its removal and possible replacement, also substantially increases the cost of the therapy.

Deer TR, et al Neuromodulation 2017;20:31–50.

EVIDENCE: perc vs perm leads

The advent of percutaneous leads resulted in percutaneous temporary lead trials regardless of whether the final permanent implant was with percutaneous or paddle leads .

Advantages: both insertion and removal do not require an open surgical procedure; less distracting pain on trial and reduced wound related complications.

In Europe and Canada permanent lead trial is often used argumenting that the correct lead placement leading to optimal paresthesia coverage is the most challenging aspect of SCS therapy and may at times be difficult to replicate. Permanent anchored lead trial determines less radiation exposure to the patient and the physician.

EVIDENCE: perc vs perm leads

	PERM LEAD	TEMP LEAD
WOUND INFECTIONS	6.52%	1.35%
POOR WOUND HEALING	4.35%	0%

Permanent lead trial group can experience persistent wound inflammation necessitating removal of the SCS device.

Poor wound healing with clinical development of chronic inflammation are related to the development of a biofilm particularly with the implantation of a foreign body.

The permanent lead develops adherent bacteria as a result of reopening the wound, or during the trial via the back wound or even traversing to it via the externalized lead extension. The device could require removal to treat the patient and resolve the condition.

Moreover a back wound may lead to worsening back pain up to 6 days , leading to a false negative or distract from the original pain symptoms leading to a false positive.

OTHER ELEMENTS FOR SUCCESSFUL TRIAL

Characteristics such as pain location and history of spinal surgery history appear to be relevant.

Biological and socioeconomic factors, which have been previously deemed important in the literature , did not significantly correlate with successful trials.

Anatomical and biochemical changes brought on by the surgery itself may directly or indirectly affect therapeutic efficacy of SCS trials.

It is unclear why older age is associated with lower odds of a successful trial, eventually factors such as longer duration of chronic pain, insomnia, and depression may play a role; there is also an hypersensitized microglial response to neuropathic pain with aging.

WAVEFORM AND TRIAL: tonic

There is a positive association of SCS waveform with trial outcomes.

1) Tonic stimulation appeared to be the most optimal for increasing the odds of trial success.

Tonic waveform is purported to work via the lateral discriminatory pathway to activate the dorsal columns of the spinal cord to elicit paresthesia. With tonic waveform stimulation, paresthesia-based mapping is used to cover all areas of pain with a focus on somatosensory aspects of pain (pain location, pain category, and intensity) . Apparently paresthesia-based sensory feedback during the SCS trial period allows patients to better detect whether there is a change in their baseline pain or not.

WAVEFORM AND TRIAL: paresthesia-free waveforms

2) Burst and HF10 stimulation are paresthesia-free and result in little sensory feedback . It may be more challenging for some patients to detect changes in their baseline pain without the paresthesia-based feedback.

HF10 and burst stimulation are purported to differentially target the medial and mediolateral pathways, respectively; these pathways have been suggested to be nonspecific and process affective/ emotional aspects of pain.

It is possible that **a trial period of 3 to 10 days is too short** a period for emotional process to allow patients to appreciate substantial changes in their baseline pain.

WAVEFORM AND TRIAL

The variable nature of chronic pain, both among different patients and over time for each patient, requires variable treatment options.

Treatment failure in patients implanted with SCS systems using single-option waveform might therefore be turned into treatment success using a device able to offer multiple options that can provide individualized or customized therapy based on each patient's individual needs and/or activities of daily living.

WIRELESS CHOICE

Newer wireless technology has eliminated the need for a percutaneous electrical connection, allowing the trial phase to be extended as long as necessary, testing as many waveforms and settings as needed to achieve and confirm success or failure of treatment.

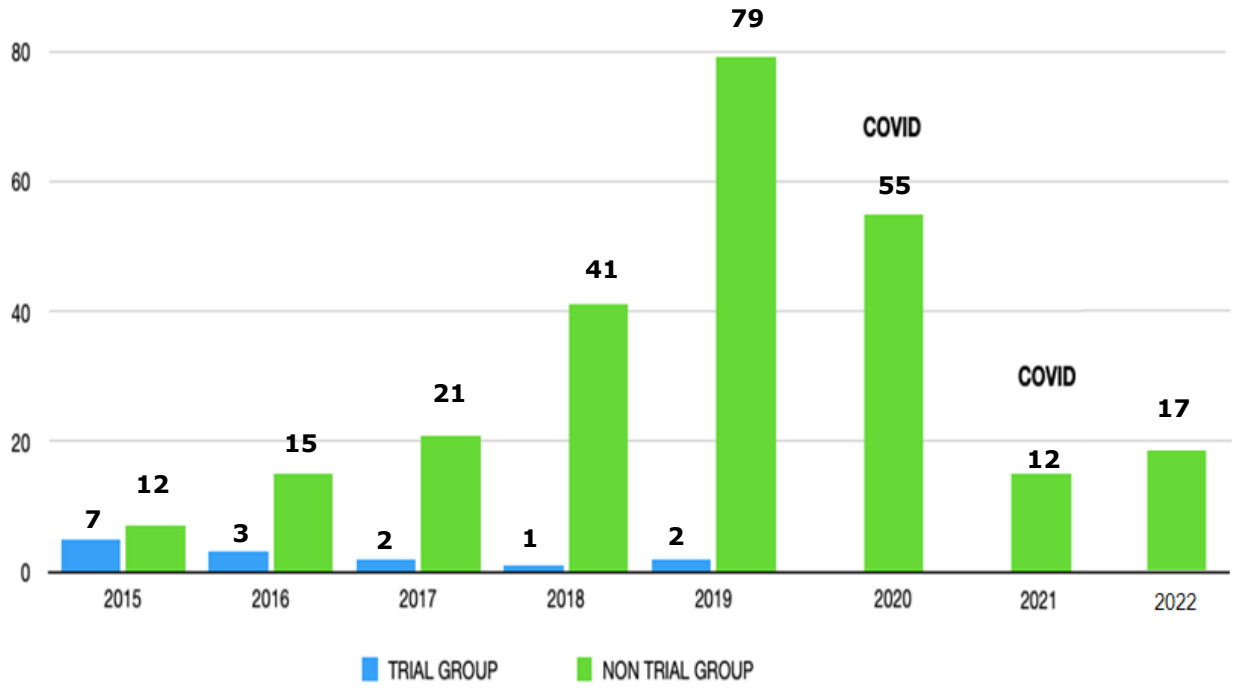
A successful implant may then remain in place permanently, eliminating the need for its removal and for implantation of new components (generator, extension cables, and new electrodes when required) that expose patients to additional discomfort and the risk of additional cost to payers

Perryman LT, et al Tech Reg Anesth Pain Manag 2012;16:102–105.
Pope JE, et al. Neuromodulation 2017;20:543–552.
Dietvorst S,et al Neuromodulation 2017;20:600–605.
Deer TR, et al. Pain Med 2008;9:S93–S101.

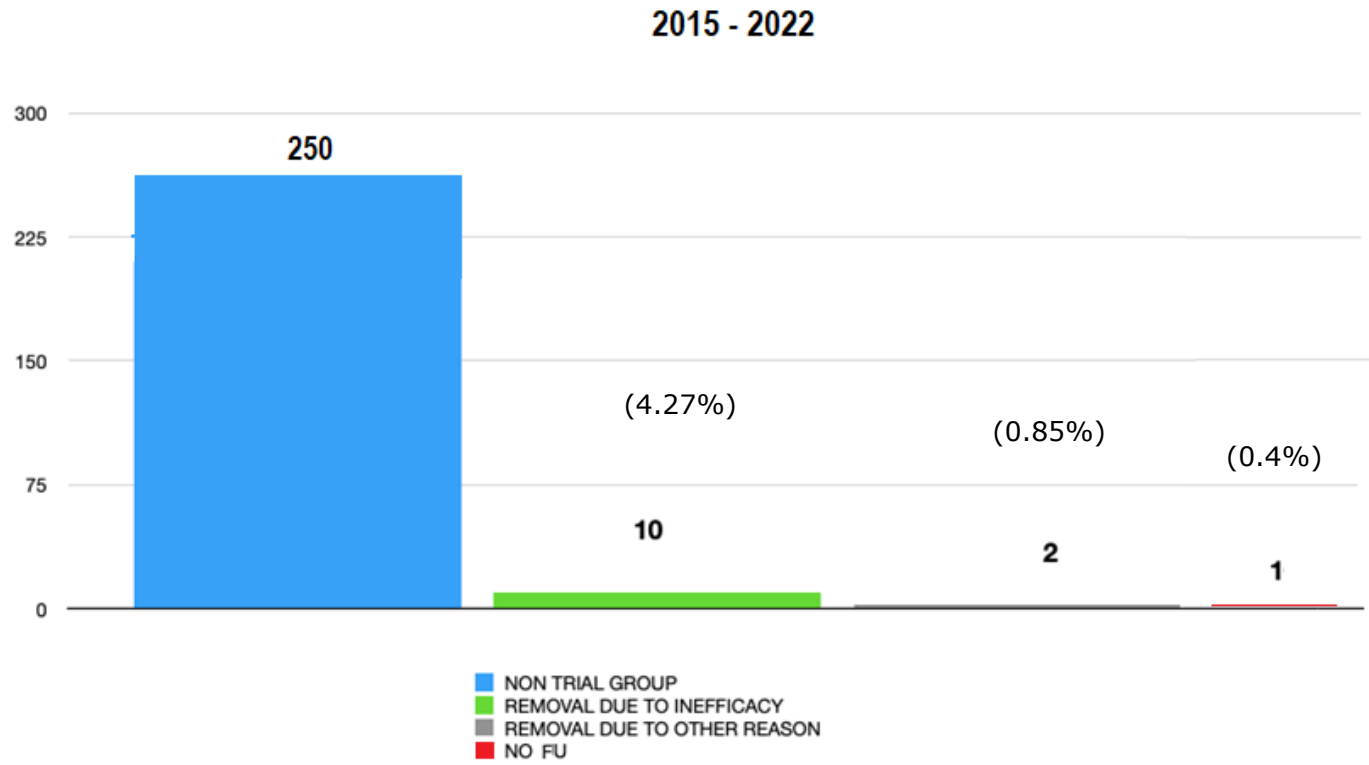
PERSONAL EXPERIENCE

1. Accurate screening and adequate preop information.
2. Preop antibiotics, double disinfection (alcoholic chlorhexidine and povidone iodine), adequate LA, surgical incision before needles insertion (at least three vertebral bodies), accurate coagulation, smooth dissection
3. "On-table" electrodes impedance evaluation and accurate evaluation of anatomical position
4. Pocket confection (lateral or sovragluteal area)
5. Absorbable interrupted sutures/staples for paravertebral incision, intradermal skin closure (pocket)

PERSONAL EXPERIENCE



PERSONAL EXPERIENCE



Real-World Outcomes in a Chronic Pain Patient Cohort Undergoing a Single-Stage SCS-Implantation Procedure

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Disclosures:

Study sponsored by Boston Scientific.

* Single-Stage Study Group: Investigators on file

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INTRODUCTION

Spinal Cord Stimulation (SCS) has been shown to be an effective treatment in the management of chronic pain. Typically, patients who have been selected as good candidates for neuromodulation get the leads implanted for on-table testing and undergo a temporary trial period where they experience SCS therapy for a few days with an External Test Stimulator (ETS). Based on success of their trial period, one proceeds to implant the SCS implantable stimulator. Based on success of their trial period with SCS, one proceeds to receive the SCS System. Recent reports have questioned the clinical value and associated cost of such screening trials in the treatment of chronic pain.[1,2]

We assessed the clinical outcomes of all patients, as part of an ongoing multi-center observational case series, who underwent a single-stage procedure (i.e., no external temporary trial period) as part of their SCS system implantation.

METHODS

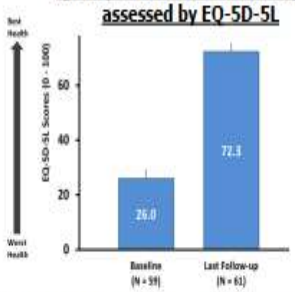
Study Design	Multicenter, Consecutive, Observational, Case-Series (all data collected by site personnel)
Study Device	Spectra WaveWriter, WaveWriter Alpha, Montage, Novi, Precision, Precision Spectra SCS Systems (Boston Scientific) with the following capabilities: • Multiple Independent Current control (MICC) with Illumina 3D targeting • Combination therapy • Multiple waveforms • Advanced field shape • Waveform automation
Study Patients	123 chronic pain patients who underwent a singe-stage SCS implant (i.e., no temporary trial period)

RESULTS

Baseline Characteristics (n = 123)

Gender - Females (%)	49.6% (61/123)
Age [Mean (SD)]	59.3 (14.2) years n = 120
Pain Location (%) (may have multiple locations)	Low Back and Legs (81.3%)
	Lower Limbs (50.4%)
	Upper Limbs (6.5%)
Pre-Trial Overall NRS [Mean (SD)]	8.2 (1.2) n =123
Follow-up Duration [Mean (SD)]	304 (378) days n = 123

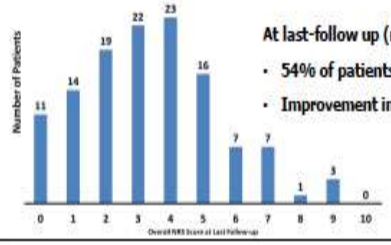
Quality of Life at last follow up as assessed by EQ-5D-5L



Overall Pain Scores at Baseline and up to 12-months post-implant

A 5.2-point improvement (8.2 → 3.0) in overall pain scores was reported at 3 months and sustained up to 12-months post-implant (8.2 → 3.0, Δ = 5.3) [p < 0.0001]

Distribution of Overall Pain Scores at Last Follow up (n = 123)



At last-follow up (mean = 304 days):

- **54% of patients (66 of 123) reported a pain score of 3 or less**
- **Improvement in quality of life (26 -> 72 on EQ-5D-5L VAS scale) noted**

CONCLUSIONS

- Results from this ongoing multicenter observational series demonstrate significant improvement in clinical outcomes and quality of life in patients (n = 123) who underwent a single-stage SCS implantation procedure (i.e. no temporary trial)
  - A 5.2 pt. improvement was noted at 3 months and sustained up to 12 months ($p < 0.0001$)
  - At last follow up, 54% of patients reported a pain score of 3 or less and significant improvement in quality of life (as assessed by EQ-5D-5L)
- Real-world evidence demonstrating that a single-stage implantation procedure may be beneficial to some patients in SCS suggests that future critical analysis and/or revision of established clinical practice guidelines may be considered, as it pertains to screening trial conditions in light of specific patient conditions and selection process for SCS therapy.

REFERENCES

1. Eldabe S, Duarte RV, Gulve A, Thomson S, Baranidharan G, Houten R, Jowett S, Sandhu H, Chadwick R, Brookes M, Kansal A, Earle J, Bell J, Robinson J, Walker S, Rhodes S, Taylor RS. Does a screening trial for spinal cord stimulation in patients with chronic pain of neuropathic origin have clinical utility and cost-effectiveness (TRIAL-STIM)? A randomised controlled trial. Pain. 2020 Dec;161(12):2820-2829
2. Weinand ME, Madhusudan H, Davis B, Melgar M. Acute vs. Prolonged Screening for Spinal Cord Stimulation in Chronic Pain. Neuromodulation. 2003 Jan;6(1):15-9.

* Single-Stage Study Group: Investigators on file

CONCLUSIONS

- SCS screening trials should certainly no longer be mandatory.
- Future patient selection for SCS should be based on careful multidisciplinary clinical assessment of their suitability including a psychological evaluation by an experienced psychologistpal tool on the appropriate referral and selection of patients with chronic pain for SCS has been published, supporting reliance on multidisciplinary selection rather than trial periods as the dominant criterion to predict successful long-term SCS outcome.
- The COVID-19 pandemic raises additional concerns into risks associated with potentially avoidable 2-stage surgery due to a screening trial of SCS.
- SCS Trial increases costs in a United Kingdom NHS setting

Eldabe S, et al PAIN 2020; 161 (12) 2820-29 doi: 10.1097/j.pain.0000000000001977