Hypoglossal Nerve Stimulation Electrode Malfunction: Approaches for Diagnosis and Management

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Introduction

- Hypoglossal nerve stimulation (HNS) is a therapy offered to treat patients with obstructive sleep apnea (OSA) who cannot tolerate continuous positive airway pressure (CPAP).
- Inspire HNS systems (Inspire Medical Systems, Golden Valley, MN) are composed of an implantable pulse generator, sensing lead, and a stimulation lead to stimulate hypoglossal nerve distally.[1]
- Consumer sleep technologies are an emerging technology to track sleep.[2]
- **Objective**: Describe clinical presentation of a malfunction of the stimulation lead, and how use of consumer sleep technologies can be used to track HNS malfunction.

Case Presentation

A retrospective chart review from February 2018 to May 2025 of two patients with malfunction in their HNS implants was conducted.

Patient 1

- 65-year-old woman with pre-operative AHI of 64 events/hour who underwent a successful HNS surgery in August 2020.
- For 2 years, patient reported no problems and achieved post-operative AHI of 11 events/hour at 1.2 (+-+) setting.
- In November 2022, patient reported worse sleep and SnoreLab app showed increased snoring.
- Impedance testing demonstrated that the middle stimulating electrode was not functional.
- The HNS settings were then reconfigured to -0- electrode settings, leading to therapeutic AHI of 5 events/hour at 1.0V (0-0) setting.

Patient 2

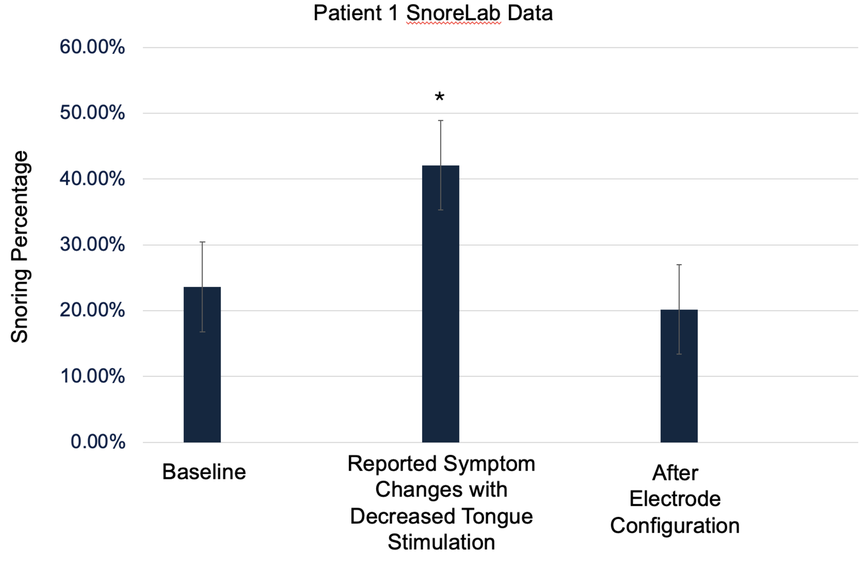
- 72-year-old woman with pre-operative AHI of 24 events/hour who underwent successful HNS surgery in February 2018.
- For 6 years, patient reported no problems and achieved post-operative AHI of 12 events/hour at 2.5V (+-+) setting.
- In February 2025, patient reported worse sleep.
- Impedance testing demonstrated that the middle stimulating electrode was not functional.
- The HNS settings were then reconfigured to -0- electrode settings, leading to therapeutic AHI of 9 events/hour at 0.5V(0-0) setting.

Case Presentation

Figure 1. Impedance testing results for two patients. Impedance values greater than 2000 indicate electrode configuration abnormalities. The impedance values, >7000 ohms, for +-+ and 0-0 electron configurations imply that there is a central electrode voltage malfunction.

	Patient 1			Patient 2		
Voltage	+-+	0-0	-0-	+-+	0-0	-0-
1.5	>7000	>7000	1236	>7000	>7000	1220
2.0	>7000	>7000	1231	>7000	>7000	1274
2.5	>7000	>7000	1326	>7000	>7000	1022
3.0	>7000	>7000	1138	>7000	>7000	1123

Figure 2. SnoreLab scores which measured snoring percentage for Patient 1. Asterisk denotes significant difference compared to snoring percentage recorded at Baseline. During the phase with reported symptom changes with decreased tongue stimulation, the patient displayed a significantly higher snoring percentage compared to Baseline measurements (p< 0.001).



Discussion

- We report the first description of Inspire implant stimulation lead malfunction and describe presenting symptoms and an approach to evaluation with impedance testing and reconfiguration of the electrode settings with improvement in snoring and sleep apnea symptoms.
- Spontaneous HNS stimulation lead failure is a potential source when patients report worsening OSA related symptoms.
- Consumer sleep technology, such as SnoreLab, can provide sleep metrics to identify return of snoring and symptoms at home.
- Inspire IV and Inspire V require longitudinal monitoring for consistent results and long term OSA treatment.
  - Both implants use the same stimulation wire type as reported in this series.

Conclusions

- Understanding the presentation and the potential for malfunction of the stimulation lead assist providers in the long-term management of hypoglossal stimulation devices.
- Impedance testing results help identify stimulation electrode malfunction, and clinical exam may demonstrate reduced or abnormal tongue motion.
- Signs and symptoms of OSA severity worsening require investigation of the implant and comprehensive understanding of potential points of abnormal function.

References

1. Schwartz AR, Bennett ML, Smith PL, et al. Therapeutic electrical stimulation of the hypoglossal nerve in obstructive sleep apnea. *Arch Otolaryngol Head Neck Surg*. 2001;127(10):1216-1223. doi:10.1001/archotol.127.10.1216
2. Performance of seven consumer sleep-tracking devices compared with polysomnography - PubMed. Accessed February 20, 2025. https://pubmed.ncbi.nlm.nih.gov/33378539/